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Thirty-sixth Annual Report

OF

The Connecticut Agricultural Experiment Station

Being the annual report for the year ending October 31

1912

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THE TUTTLE, MOREHOUSE & TAYLOR COMPANY

CONNECTICUT AGRICULTURAL EXPERIMENT STATION.

OFFICERS AND STAFF.

SEPTEMBER 30, 1912

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BUILDINGS AND GROUNDS.	WILLIAM VEITCH, *In Charge.*

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Report of the Board of Control
of
The Connecticut Agricultural Experiment Station.

To His Excellency, Simeon E. Baldwin, Governor of Connecticut:

The Board of Control of The Connecticut Agricultural Experiment Station herewith respectfully submits its report for the year ending November 1, 1912.

The following changes in the Station staff have occurred:

Samuel N. Spring, B.A., M.F., who has served the State and Station most efficiently as their forester for three years, resigned on October 1, 1912, to accept a professorship in Cornell University.

Mr. W. O. Filley, the assistant forester, has been appointed to fill this vacancy in our staff, and Mr. A. E. Moss, M.F., a graduate of The Connecticut Agricultural College and of the Yale Forest School and later a forestry assistant of the United States Forest Service, has been appointed assistant Station forester.

R. B. Roe, B.A., who has served as an assistant chemist for three and one-half years, resigned in October to accept a position in a chemical research laboratory.

Harry B. Kirk, formerly for two years assistant in economic zoölogy in the Pennsylvania Department of Agriculture, was appointed an assistant in the Entomological Department in February, 1912.

An exhibit illustrative of the work of the several departments of the Station was made at three of the agricultural fairs during the fall, with members of the staff in attendance to explain it and answer questions. While such exhibits have seriously interrupted the Station work, they have proved to be most effective in bringing its results immediately and in a striking way to those who should get practical benefit from them.

The same purpose is also served by frequent addresses before granges, farm institutes, field meetings, etc. During the year

ninety addresses of this sort have been made by members of the staff in response to requests.

While the attendance of the Station staff at fairs, farm institutes and other meetings has been necessary and profitable, it has taken much time which was greatly needed for its experimental study and work, which are the Station's special sphere.

The rapid development of the so-called agricultural extension, in which the national government is expected to coöperate with the agricultural colleges, should reduce the necessity for these outside activities on our part. The greatest efficiency of the Station can only be secured by the uninterrupted course of its special work. On the other hand, the extension of agricultural teaching and demonstration by new agencies abundantly provided with funds but not so amply supplied with trained teachers puts an added responsibility on both College and Station to do thoroughly and with the least possible interruption the sound teaching and painstaking research on which the whole agricultural extension effort must rest, if it is not to prove an injury rather than a blessing.

The valuable Station library, now numbering about 8,000 volumes, had until this year no suitable place for orderly arrangement and easy reference. The quarters formerly used for a chemical laboratory have recently been equipped with steel shelving, electric lights and other necessary furnishings, and the general consulting library with the various card catalogues has been installed in it, under the direction of Miss Cole, the librarian.

The Report of the Station staff, which is printed with this report of its Board of Control, makes unnecessary any detailed statement of what has been done. The Report itself describes only that part of the work which is of present importance to farmers, but besides this there have been printed in scientific journals eighteen papers giving the results of Station investigations.

The following incomplete summary will show the scope of the Station's work:

Chemical Department.

Seven hundred and eighty samples of fertilizers and manures and 273 of feeding stuffs have been analyzed and the results published. Twelve hundred and fifty samples of human food

products and 395 samples of drugs have been examined, the results published, adulterated samples reported to the Dairy and Food Commissioner, and evidence furnished in court trials in eighteen cases.

Over 2,000 samples of food products have been weighed or measured as a basis for establishing regulations on the subject, as required by an Act of the last General Assembly.

An improved method of determining starch in meat products has been devised and much coöperative work done for the Association of Official Agricultural Chemists.

Botanical Department.

The orchard experiment at Yalesville (now in its fourth year) on a block of 900 trees is planned to determine the effect of fertilizers on growth, yield, winter injury, occurrence of yellows, and bearing life of the trees.

The effects of different sprays on peaches, apples and other fruits have been carefully tested.

Studies of muskmelons—with reference to varieties, spraying and disease resistance,—of the calico of tobacco, of peach yellows, and extensive experiments and study of the nature and spread of the chestnut blight are also in progress.

Seeds sent by seedsmen and farmers, and some samples bought by the Station have been tested as to vitality and, where necessary, as to purity, to the number of 863.

Entomological Department.

This department has determined the life histories of three little-known and destructive insects and the means for combating them.

Studies on the white pine weevil are not yet concluded.

It has coöperated by furnishing inspection, information and advice to organizations and individuals who have engaged in mosquito control work.

It has inspected the 54 nurseries of the State, covering some 770 acres; 30 orchards and gardens; 987 packages of imported nursery stock; and 153 apiaries containing 1431 colonies.

The gypsy moth has been so nearly exterminated at Stonington that very careful search fails to discover a single specimen, and

at Wallingford very few specimens have been found. These two very threatening invasions have thus been stamped out.

The brown-tail moth work in the northeastern part of the State has shown a great diminution of the pest where work was done last year, but a gradual spread of the invasion. This work could and should be done by local authorities and not left for the State.

Forestry Department.

About 528,000 forest seedlings have been supplied at cost to owners of Connecticut forest land for planting, and about 290,000 are ready for sale in 1913.

The Station's experimental forests at Rainbow and Enfield have needed little except fire protection.

About 76,000 seedlings have been set in the State Forests. One lot of twenty acres badly infected with chestnut disease has been cut clean and is to be set to pine in 1913. No fire has occurred on either of these tracts.

An accurate type and stock map of the Portland Forest has been made, with a plan for the permanent management of the forest.

The number of spring fires, 254, and the estimated damage, $21,700, have been much less than in the previous year, owing partly to the plentiful rain and partly to increased efficiency of the fire warden service. During the danger season two lookout stations and fire patrols of certain railroad lines—services which were paid for chiefly by a United States government appropriation—greatly helped in promptly discovering and extinguishing forest fires.

Twenty-seven examinations of forest tracts ranging in size from 10 to 500 acres were made for and at the request of the owners and advice given as to their treatment.

A full report has been made on the woodworking industries of the State in coöperation with the United States Forest Service and will soon be published.

The State forester was made a member of the Commission on the Taxation of Forest Land, and the field work necessary to secure information on the matter was put in his charge. This has required a very careful and laborious study of forest conditions, the results of which will appear in the Commission's report

Plant Breeding.

(Supported by Adams Fund.)

Mr. Hayes has continued the study of tobacco, to determine precisely how different measurable characters of the plant—such as size, shape and number of leaves, height of plants, etc.—are inherited by crosses or hybrid plants, and to discover any fixed relation that there may be between these and the subtile characters which make "quality." The practical purpose is to find a way in which improved strains of tobacco may be produced. Many thousand measurements of single plants have been made for this study, and 35 row selections of 250 plants each have been separately harvested, cured and fermented and are immediately to be sorted and judged as to quality by experts. The commercial side of this work is in coöperation with the United States Department of Agriculture.

Further tests of the merits of using for seed first generation hybrids of corn have been made at the experiment field, as also a study of the effects of crossbreeding and inbreeding of tomatoes. Other work has been on selections of rye, testing the value of selection in forest seeding, and on developing an improved variety of muskmelon.

Protein Research.

(Supported by Adams Fund.)

This department, being devoted wholly to technical research, is supported by the Adams Fund, which, according to Act of Congress, must be spent wholly for such work.

The nutritive effect of the separate proteins or flesh-forming materials of food has been the main object of study this year and has yielded very valuable results.

The Station correspondence has involved the writing of 11,922 letters and manuscript reports. (Main office 5,357, chemical department 623, botanical 507, entomological 2,823, forestry 2,107, plant breeding 200, protein research 305.)

During the year there have been issued a report of 445 pages with 32 plates in an edition of 10,000 copies, and four bulletins aggregating 77 pages with 12 plates in editions of 9,500.

A technical bulletin of 45 pages with 5 plates was issued in an edition of 2,000 copies.

We wish again to call attention to the pressing needs of the Station. In 1895 the General Assembly appropriated $10,000 to the Station as an annual payment for its support, and the same amount has been paid yearly ever since. But in the meantime it has, by various Acts, greatly increased the amount of work required of the Station without in any case providing additional funds to meet these requirements, nor was this work of a kind which could be paid from funds appropriated by the national government. Thus:

In 1899 the Assembly passed a law regulating the sale of cattle feeds, requiring the Station to collect samples and make and publish analyses of the different brands yearly, but with no appropriation for the work.

In 1901 the law regarding insect pests was passed, appropriating to this Station $3,000 for the use of the State Entomologist in executing the law, creating the office of State Entomologist but providing that he shall receive no salary other than that which he received as a member of the Station staff, i. e., his salary was to be paid from Station funds.

At the same session the office of State Forester was created and with the same provision as to payment of his salary.

An Act of this session also required that all apparatus used in determining fat in dairy products as a basis of payment should be tested and marked by this Station or by the Agricultural College, but no appropriation was made for it. All this work, not very large in any one year, has been done without charge at this Station.

In 1903 a law was passed regarding renovated butter, which placed further work on this Station.

In 1907 the Assembly passed a bill much more elaborate than previous ones on the same subject, to prevent the sale of adulterated, misbranded or poisonous foods, drugs and liquors. It only repealed those parts of existing statutes which were inconsistent with it. This law, with the increased public attention which has been drawn to the subject and with the extension of the work to cover drugs and liquors, has greatly increased the work required of the Station with no addition to its means of meeting the demand.

The General Assembly recognized the increased work involved by increases in the salaries of the Dairy and Food Commissioner and his deputy commissioner and in provision for the expenses of their office, but made no further provision for the chemical work involved.

The Assembly in 1911 passed an Act concerning Adulteration of Turpentine, which is to be enforced by the Dairy and Food Commissioner and the Director of this Station "acting jointly." About 150 samples of turpentine have already been examined, of which 30 were adulterated.

The same session of the General Assembly passed an Act requiring a statement of the net quantity of contents to be marked on all food products in packages, and providing that the *Dairy and Food Commissioner and the Director of this Station* shall establish rules regarding allowances to be made for variations from the alleged net weight of such packages. There are no published data on the subject and we are therefore making an extensive series of weighings of certain package goods and containers to determine the present range of net weights in the market. The Dairy and Food Commissioner buys what goods are required; the Station does the work.

In no one of the cases cited above has any appropriation been made to the Station to cover the cost of the work.

The result has been that the Station, at the sacrifice of agricultural experiment and research work which is its proper function, has been forced to do this control work and to use for it funds which should rather have been devoted to the object for which this Station was established: namely, agricultural investigation and experiment.

At the same time, the proper demands made on the Station for assistance in all branches of farming have greatly increased. It is no longer possible for the Station to meet all these. Its income can no longer meet its expenses and unless it is more adequately supported it will be necessary to curtail its present field of work, making it rather a control station than an agricultural experiment station. The call for sound research in the interest of practical agriculture was never so pressing as it is now. It surely is not the time to force this, the first established Station in the country, to curtail its experimental work.

The above statement of the facts and present situation requires no argument to show the reasonableness of the request of this Board that the General Assembly will increase the annual Station appropriation by $7,500, which by careful estimate is the amount which must be yearly spent in the control work above mentioned for which the State has never made appropriation, and the appropriation for insect pest work by $1,000.

All of which is respectively submitted.

GEORGE A. HOPSON, *Secretary.*

REPORT OF THE TREASURER, 1912.

E. H. JENKINS, in account with THE CONNECTICUT AGRICULTURAL EXPERIMENT STATION for the fiscal year ending September 30, 1912.

RECEIPTS.

Balance on hand, October 1, 1911 (Analysis Fees) ..		$ 52.60
State Appropriation, Agriculture	$10,000.00	
State Appropriation, Food	2,500.00	
State Appropriation, Insect Pest	3,000.00	
State Appropriation, Gypsy Moth	2,500.00	
United States Appropriation, Hatch	7,500.00	
United States Appropriation, Adams	7,500.00	
Analysis Fees	5,500.00	
Sale of Mt. Carmel Farm to Lockwood Trust	6,000.00	
Sale of Farm Products	386.99	
Miscellaneous Receipts	75.61	
From the Lockwood Income	11,046.13	
		56,008.73
Total		$56,061.33

DISBURSEMENTS.

E. H. Jenkins, director, salary	$2,800.00
E. H. Jenkins, treasurer, salary	400.00
G. A. Hopson, salary	100.00
V. E. Cole, "	850.00
L. M. Brautlecht, "	750.00
J. P. Street, "	2,500.00
T. B. Osborne, "	2,400.00
E. M. Bailey, "	1,550.00
C. B. Morison, "	1,200.00
R. B. Roe, "	1,125.00
C. E. Shepard, "	900.00
W. E. Britton, "	2,000.00
G. P. Clinton, "	2,200.00
E. M. Stoddard, "	900.00
S. N. Spring, "	2,500.00
W. O. Filley "	1,500.00
H. K. Hayes, "	1,590.00
Edna L. Ferry, "	1,008.34
H. Lange, "	925.00
V. L. Churchill, "	825.00

Wm. Veitch, salary	$ 675.00	
E. L. Avery, "	480.00	
H. W. Kiley (Labor)	728.00	
Wm. Pokrob "	728.00	
C. D. Hubbell "	728.00	
Geo. Graham "	728.00	
M. H. Jagger "	520.00	
Labor	3,746.46	
Publications	676.18	
Postage	205.81	
Stationery	423.52	
Telephone and Telegraph	162.53	
Freight and Express	285.49	
Gas, Kerosene and Electricity	748.11	
Coal	1,625.70	
Water	148.88	
Chemicals and Laboratory Supplies	1,205.18	
Agricultural and Horticultural Supplies	232.13	
Miscellaneous Supplies	574.69	
Fertilizers	386.61	
Feeding Stuffs	372.27	
Library and Periodicals	750.77	
Tools and Machinery	464.17	
Furniture and Fixtures	1,184.67	
Scientific Apparatus	166.31	
Live Stock	200.00	
Traveling by the Board	106.61	
Traveling by the Staff	1,144.31	
Traveling in connection with Adams Fund Investigations	98.11	
Fertilizer Sampling	233.64	
Food Sampling	183.34	
Insurance	140.00	
Insect Pest Appropriation to State Entomologist	3,000.00	
Contingent	186.50	
Lockwood Expenses	400.00	
Gypsy Moth Appropriation to State Entomologist	2,500.00	
New Buildings	58.00	
Betterments	389.89	
Repairs	328.27	
Rental of Land	160.00	
		$55,008.4[illegible]

Balance on hand, October 1, 1912:

Analysis Fees $755.17

NEW HAVEN, Oct. 31st, 1912.

THIS IS TO CERTIFY that we have examined the accounts of E. H. Jenkins, Treasurer of The Connecticut Agricultural Experiment Station, for the year ending Sept. 30, 1912, have compared the same with the vouchers therefor and found them correct.

WILLIAM P. BAILEY,
EDWARD S. ROBERTS,
Auditors of Public Accounts.

ERRATA.

Page 12. It is stated that the Humphreys, Godwin Co. has made a rebate to buyers when the cotton seed meal sold by it was found to contain less nitrogen than was guaranteed. It might be inferred from this statement that the other firms there named had not done this, but we have since been advised that the Apothecaries Hall Co., of Waterbury, and W. Newton Smith, of Baltimore, have also given similar rebates.

Page 92. The guaranteed percentage of phosphoric acid in Wizard Brand Manure, sold by the Pulverized Manure Co., Chicago, analysis number 377, is incorrectly stated as four.

The statement that this brand contains much less phosphoric acid than is guaranteed is also incorrect.

One per cent. of phosphoric acid is guaranteed and this guaranty is fully met.

Page 362, line 4 from bottom, read Moravian instead of Bavarian.

PART I.

Report on Commercial Fertilizers, 1912.

By E. H. JENKINS, *Director,* and JOHN PHILLIPS STREET, *Chemist in charge of the Analytical Laboratory.*

The statutes relating to the trade in commercial fertilizers have been fully explained in previous reports and are so generally understood by dealers that further reference to them is deemed unnecessary in this report.

OBSERVANCE OF THE FERTILIZER LAW.

During 1912, forty-four individuals and firms have entered for sale in this state three hundred and sixty-nine brands of fertilizers, classified as follows:

Nitrogenous superphosphates	266
Bone manures and "bone and potash"	29
Fish, tankage, castor pomace and chemicals	74
Total	369

SAMPLING AND COLLECTION OF FERTILIZERS.

During April, May and June, Mr. V. L. Churchill, the sampling agent of this station, visited one hundred and fifteen towns and villages in Connecticut to draw samples of commercial fertilizers for analysis. These places were distributed as follows:

Litchfield County	10
Hartford County	37
Tolland County	8
Windham County	9
New London County	9
Middlesex County	11
New Haven County	22
Fairfield County	9
	115

In these places seven hundred and fifty-seven samples were taken.

The agent could not find the following brands which had been entered for sale in the state: American Agricultural Chemical Co.'s Dried Blood, Wheat and Haymaker, Ground Untreated Phos. Rock; Lister's Special 10 per cent. Fertilizer*; Munroe & Sons' Unleached Wood Ashes; National H. G. Top Dressing, Swift's Lowell Nitrate Soda, Muriate Potash, Tankage.

With two exceptions, no analyses of these brands could therefore be made.

CLASSIFICATION OF THE FERTILIZERS ANALYZED.

	Number of Samples.
1. *Containing nitrogen as the chief active ingredient.*	
Nitrate of soda	15
Dried blood and blood tankage	3
Cotton seed meal	295
Castor pomace	3
Linseed meal	1
2. *Containing phosphoric acid as the chief active ingredient.*	
Ground phosphate rock	3
Basic slag or Thomas phosphate	14
Precipitated bone	3
Dissolved rock phosphate or acid phosphate	10
3. *Containing potash as the chief active ingredient.*	
High grade sulphate of potash	9
Double sulphate of potash and magnesia	2
Muriate of potash	14
Kainit	3
Vegetable potash	1
Cotton boll and cotton hull ashes	8
4. *Containing nitrogen and phosphoric acid.*	
Fish manures	14
Tankage	12
Egg tankage	1
Kanona	1
Bone manures	35
5. *Mixed fertilizers.*	
Acid phosphate and potash	3
Commercial mixtures	279
Home mixtures	16
6. *Miscellaneous fertilizers, manures and amendments*	15

EXPLANATIONS CONCERNING THE ANALYSES.

The analyses given on the following pages show the percentage quantities of nitrogen, phosphoric acid and potash present in the samples, and, where possible, their solubilities. These solubilities give some indication as to the probable availability to crops.

Each printed analysis is the average of two closely agreeing analyses made independently by two expert analysts following the methods of the American Association of Official Agricultural Chemists.

Samples are numbered consecutively as received. The numbers having risen to 28,000, the numeration has been begun this year at unity again for the sake of economy of space in printing.

The average cost of most of the samples is calculated from the prices quoted by the sellers of the goods. In some cases quite different prices are charged by dealers for the same goods. *These quotations, therefore, should be regarded only as a general guide,* not at all as a basis for individual purchases.

When materials contain either nitrogen, phosphoric acid or potash as the single fertilizer ingredient, the cost per pound of that ingredient is easily calculated from the ton price and the analysis. Thus, if a sample of muriate of potash contains 50.2 per cent. of potash, which is 1004 pounds per ton, and costs $42.50 per ton, actual potash costs 4250 ÷ 1004, or 4.2 cents per pound.

Fertilizers which are mixtures of various raw materials and contain two or more of the fertilizer ingredients above named are reported with an attached valuation.

Valuation of Fertilizers.

There is so much misunderstanding as to the meaning of the term valuation as it is used in our fertilizer reports that particular attention is called to the following explanations:

The valuation of a fertilizer is the result of calculating the retail cash cost at freight centers of an amount of nitrogen, phosphoric acid and potash in high grade materials equal to the amount contained in one ton of the fertilizer. It is a valua-

Valuation no more shows the fair retail price of a fertilizer than quotations of steel billets can show the fair price for small amounts of structural steel of a specified shape. If, however, the prices of steel remain fairly uniform, a comparison of these quotations with the rates charged by different companies *in open competition* for the finished product is a help, though not a perfect guide, to the buyer in studying the bids of different manufacturers.

To illustrate: Of two fertilizers, A and B, let us assume that A contains 3.5 per cent. of organic nitrogen, 4.5 per cent. of water-soluble, 3 per cent. of citrate-soluble and 1 per cent. of insoluble phosphoric acid and 6 per cent. of potash, and sells at retail for $35.00. B contains 2.0 per cent. organic nitrogen, 3.5 per cent. of water-soluble, 3 per cent. citrate-soluble and 4 per cent. insoluble phosphoric acid and 8 per cent. of potash, and retails for $32.00.

We assume that both are in good condition, sold by well-known and reputable manufacturers, and the prices are the best obtainable for these two brands. The question is, which is the better purchase: 70 pounds of nitrogen, 150 pounds of soluble phosphoric acid, 20 pounds of insoluble phosphoric acid and 120 pounds of potash at $35.00; or 40 pounds of nitrogen, 130 pounds of soluble phosphoric acid, 80 pounds of insoluble phosphoric acid and 160 pounds of potash for $32.00. Obviously the first thing to do is to get the approximate value of all these separate ingredients in one figure so as to have some common basis of comparison. In a ton of A are 70 pounds of organic nitrogen, which can be bought for about 19 cents a pound; 150 pounds of soluble phosphoric acid, which can be bought for 4½ cents per pound in form of acid phosphate; 20 pounds of insoluble phosphoric acid, for which we may allow 2 cents per pound; 120 pounds of potash, which can be bought in form of muriate for 4¼ cents per pound.

Calculating as follows,

$$70 \times 19 = 13.30$$
$$150 \times 4\frac{1}{2} = 6.75$$

it appears that the plant food in fertilizer A can be bought, at freight centers, in raw materials, for about $25.55, and a similar calculation shows that the corresponding figure for fertilizer B is $21.85. These two figures are the "valuations" of the two fertilizers. Each gives a single figure to represent the ***trade value of the actual plant food*** in each of these two fertilizers, A and B, but they do not at all show the fair market price of the goods.

Valuations do not, of course, show the agricultural value of the plant food in fertilizers. Nor do they show the cost to the manufacturer of the stock which he used in the mixture. His profit comes in part from skill and judgment in buying the plant food on the most favorable terms. The valuation shows simply what it would cost the farmer to buy the same amount of plant food as the mixed fertilizer contains, at freight centers, unmixed, in raw materials of good quality.

But the cost of the plant food contained in a mixed fertilizer is but one item, though the largest single item, in its cost. Other items are grinding and mixing, bags, freight, agents' commissions, as well as other items, overhead factory charges, losses and profits.

It cannot be stated too emphatically that the valuation does not and cannot show the fair retail price of fertilizers, but only one item—the largest item to be sure—of the cost. In fact one must add ten dollars or more to the valuation to approximate what would be, in most cases, a fair selling price.

Fertilizer A costs $35.00, and the plant food in it has a valuation of $25.55. Fertilizer B costs $32, and its plant food a valuation of $21.85. The charges for converting the raw materials into a uniform mixture and delivering it are $9.45 in A and $10.15 in B; or, in A about 37 per cent. of the valuation of the plant food in it, and in B 46.4 per cent.—figures which we call percentage difference between cost and valuation. Assuming the substantial accuracy of the costs of plant food and that the nitrogen, phosphoric acid and potash are equally valuable in both brands, it is clear that A is a better purchase than B. For while the difference between cost and valuation (i. e., the cost of manufacture and selling) is only 70 cents more

To recapitulate:

1. **Valuation represents one item, and the largest item, in the cost of mixed commercial fertilizers. It is a valuation of only one factor which makes up the market price, namely, the average market cost of the untreated raw materials of high quality which enter into its composition.**

2. **It affords a basis for estimating, approximately, the fair selling price.**

3. **It affords a basis of comparing fertilizers which differ considerably in composition and price.**

4. **It does not represent the fair selling price.**

5. **It does not show the agricultural value of the ingredients in it.**

The trade-values used in the calculations made in this report are only approximately correct, for market prices constantly fluctuate, but they are accurate enough to be used to compare fertilizers which are on sale at the same time.

Trade-Values of Fertilizer Elements for 1912.

The average trade-values or retail costs in market, per pound, of the ordinarily occurring forms of nitrogen, phosphoric acid and potash in raw materials and chemicals, as found in New England, New York and New Jersey markets during 1911 and adopted at a conference of representatives of the New England, New York and New Jersey Stations in March, 1912, are as follows:

	Cents per pound.
Nitrogen in nitrates and ammonia salts	16½
Nitrogen, organic, in fine dry fish and blood	22
in cotton seed meal and castor pomace	20
in fine* bone and tankage and in mixed fertilizers	19
in coarse* bone and tankage	15
Phosphoric acid, water-soluble	4½
citrate-soluble† and in fine bone and tankage, cotton seed meal and castor pomace	4
in coarse bone and tankage and ashes	3½
in acidulated goods insoluble in water or citrate solution	2
Potash in high grade sulphate and mixtures free from muriates	5¼
cotton seed meal and castor pomace	5
muriate	4¼

The foregoing are, as nearly as can be estimated, the average prices at which, during the six months preceding March last, the respective ingredients were retailed for cash, in our large markets, in those raw materials which are the regular source of supply. The valuations obtained by use of the above figures will be found to correspond fairly with the average retail prices, at the large markets, of standard raw materials.

Method of Valuation of Bone and Tankage.

To obtain the valuation of ground bone or tankage the sample is sifted into two grades, that finer than $\frac{1}{16}$ inch, "fine," and that coarser than $\frac{1}{16}$ inch, "coarse."

The nitrogen value of each grade is separately computed by multiplying the pounds of nitrogen per ton by the per cent. of each grade, multiplying the product by the trade-value per pound of nitrogen in that grade, and taking this final product as the result in cents. Summing up the separate values of each grade thus obtained, together with the values of each grade of phosphoric acid, similarly computed, the total is the valuation of the sample.

Method of Valuation of Mixed Fertilizers.

The organic nitrogen in mixed fertilizers is reckoned at 19 cents per pound, nitrogen of nitrates, and ammonia salts and phosphoric acid in its three forms of solubility, at the prices given above. Potash is rated at 4¼ cents, if sufficient chlorine is present in the fertilizer to combine with it to make muriate. If there is more potash present than will combine with the chlorine, then this excess of potash is reckoned at 5¼ cents per pound, except in certain special cases, to be noted later, where carbonate of potash has been used in the mixture.

To obtain the Valuation of a Fertilizer, multiply the pounds per ton of nitrogen, etc., by the trade-value per pound. The several products give the values per ton of the several ingredients and their sum is the total valuation per ton.

Percentage Difference shows the percentage excess of the cost

the mixture expressed in percentage of the cost of the raw materials composing it.

This information helps the purchaser to determine whether it is better economy to buy the commercial mixed fertilizers, of which so many are now offered for sale, or to purchase and mix for himself the raw materials.

I. RAW MATERIALS CHIEFLY VALUABLE FOR NITROGEN.

NITRATE OF SODA OR SODIUM NITRATE.

Nitrate of soda is mined in Chili and purified there before shipment. As offered in the Connecticut market this year, it contains about 15.4 per cent. of nitrogen, equivalent to 93.5 per cent. of pure sodium nitrate. The other usual constituents are moisture and small quantities of common salt and Glauber's salt (sodium sulphate).

363. Sold by Nitrate Agencies Co., New York. Stock of J. F. Merrill, Suffield.

360. Sold by Bowker Fertilizer Co., New York. Stock of W. O. Goodsell, Bristol.

272. Sold by Coe-Mortimer Co., New York. Stock of Spencer Bros., Suffield.

270. Sold by American Agricultural Chemical Co., New York. Stocks of Chas. Templeton, Waterbury, and F. S. Platt Co., New Haven.

235. Stock of Apothecaries Hall Co., Waterbury.

533. Sold by Wilcox Fertilizer Co. Stock of T. H. Eldredge, Norwich.

539. Sold by Rogers Manufacturing Co., Rockfall.

274. Sold by L. T. Frisbie Co., New Haven. Stock of Lightbourn & Pond, New Haven.

712. Sold by Fertilizer Materials Supply Co. Stock of H. P. Beers, Greens Farms.

640. Sold by F. S. Royster Guano Co., Baltimore. Stock of C. E. Kempton, Pomfret Center.

281. Sold by American Agricultural Chemical Co., New York, per E. Manchester's Sons, Winsted. Sampled and sent by John Cotta, Portland.

188, 263 and **237.** Sold by Sanderson Fertilizer and Chemical Co., New Haven. **188** from stock of Connecticut School for Boys, Meriden; **263** sampled and sent by E. B. Sniffen, Stratford; **237** from stock bought by C. R. Treat, Orange.

ANALYSES OF NITRATE OF SODA.

Station No.	363	360	272	270	235	533	539
Percentage amounts of							
Nitrogen guaranteed	15.00	15.00	15.00	15.00	15.00	15.00	15.00
Nitrogen found	15.44	15.64	15.40	15.38	15.00	15.76	15.20
Equivalent sodium nitrate	93.75	94.96	93.51	93.38	91.08	95.69	92.29
Cost per ton	$48.00	50.00	50.00	51.25 } 55.00 }	50.00	54.00	52.00
Nitrogen cost cents per pound	15.5	15.9	16.2	16.7 } 17.9 }	16.7	17.1	17.1

Station No.	274	712	640	281	188	263	237
Percentage amounts of							
Nitrogen guaranteed	15.00	15.00	15.00	15.00	15.00	15.00	15.00
Nitrogen found	15.44	15.74	15.46	15.36	15.36	15.10	15.40
Equivalent sodium nitrate	93.75	95.54	93.87	93.26	93.26	91.69	93.50
Cost per ton	$53.00	55.00	55.00	.....	.....	.....	.....
Nitrogen cost cents per pound	17.2	17.4	17.8	.....	.....	.....	.....

The above table shows:

1. That the percentage of nitrogen in nitrate of soda, as it is sold in Connecticut, has ranged from 15.00 to 15.76. A part of this difference may be due to the absorption of water by the nitrate. For example, a bag of nitrate of soda weighing 200 pounds may contain when sold 15.65 per cent. or 31.3 pounds of nitrogen. If in transit and storage it gathers 6 pounds of moisture it will contain only 15.2 per cent. of nitrogen, but the total quantity of nitrogen in the bag will be as before, namely 31.3 pounds.

2. Nitrate could be readily bought this year at retail for $50 per ton, and a pound of nitrogen in this form costs from 15.9 to 16.7 cents.

3. The price charged by different agents for the same stock varies greatly. See No. 270.

While nitrogen in nitrate bought in small lots of agents has cost about 16.5 cents per pound, it has been bought in mixed car lots *for cash* by farmers and farmers' clubs at prices ranging from 14.9 to 15.7 cents per pound.

The great economy of buying either chemicals or mixed fertilizers *for cash* and in quantity is so obvious and has been so persistently urged by us that no further comment seems necessary.

A sample sent by the F. F. Rockwell Company of Putnam and stated to have been received by them with the label "Nitrate of Soda," **633**, contained only 14.04 per cent. of nitrogen as nitrate, 4.45 per cent. of matter insoluble in water and considerable amounts of chlorides and sulphates. It was not commercial nitrate of soda, but an impure nitrate either of soda or potash.

DRIED BLOOD AND BLOOD TANKAGE.

Two samples of dried blood drawn from stock of L. M. Benham and Andrew Ure, Highwood, Nos. **226** and **242**, contained respectively 13.00 and 13.10 per cent. of nitrogen. Over 77 per cent. of the nitrogen was in active form and its cost was 20.6 cents per pound.

A sample of Blood Tankage sent by S. L. Tuttle, Gaylord Farm, Wallingford, and bought of the Sanderson Fertilizer & Chemical Co., contained 7.50 per cent. of nitrogen and 5.83 per cent. of phosphoric acid. Eighty-two per cent. of the nitrogen present was in active forms.

COTTON SEED MEAL.

(Analyses on pages 14 to 24.)

Two hundred and ninety-five samples of this material have been analyzed this year, representing about 6,500 tons sold within the state, and a cash outlay of something over $200,000, chiefly by tobacco growers.

The analyses of these samples are given in a following table. Names of the commission men or brokers from whom the meal was bought are given where they are known, and where they are not known, the names of the Connecticut dealers are given instead. With each sample is given the number of the car in which it was received and the person or firm which bought it.

The cost of nitrogen per pound is calculated in each case by allowing $4.42 for the phosphoric acid and potash in one ton, subtracting this from the ton cost and dividing the remainder by the number of pounds of nitrogen in the ton. Undecorticated meals contain much less phosphoric acid and potash, and no cost of nitrogen is calculated for them.

Sample **419**, page 24, was drawn from car No. 67097 by Olds & Whipple. Sample **412** was drawn later from the same car by J. B. Parker, when it was received at Windsor. Full particulars as to the method of sampling in each case are not at hand, but the nitrogen determinations show the differences likely to occur if the samples are not drawn from a sufficiently large number of sacks.

A study of the table shows that

1. The highest price paid has been $35.00 for high-grade meal, the lowest $26.50, for low-grade, and the average price has been $31.20. It should be said, however, that the prices in the table are those originally charged, but where the nitrogen fell below the guaranty, the price has been in most cases proportionately reduced.
2. The per cent. of nitrogen has ranged from 7.6 to 4.87, the average being 6.58 per cent., which is 0.4 per cent. lower than last year. If there are excluded thirty samples which are very obviously undecorticated meal, the average percentage of nitrogen is 6.69, and average cost $31.50.
3. The cost of nitrogen in cotton seed meal has ranged from 23.5 to 17.4 cents and has averaged 20.2 cents per pound. From this calculation are excluded the undecorticated and very imperfectly decorticated samples.
4. The meal sold into the state this year has been of lower grade than ever before. A third of it has been sold for what it was not; that is, it has contained far less nitrogen than was claimed for it. Thus, of the 138 samples shipped by Humphreys, Godwin & Co., 44 per cent. were below guaranty; of the 86 shipped by W. Newton Smith, 16 per cent.; of the 19 sent by Olds & Whipple, with no statement of the firm from whom it was bought, 29 per cent. were below guaranty.

In this very unsatisfactory condition of things, the Station analyses make it possible for every buyer to protect himself by claiming from the seller a rebate for every unit of nitrogen deficient in the meal which he buys.

The difficulties of commission men in the matter of guaranties *have been sufficiently explained in previous reports.* The amount of time and trouble now spent in adjusting claims for shortage of nitrogen, if applied by them to forcing manufacturers to tell the truth regarding their output of meal, would put the trade on a more satisfactory basis.

Special attention is called to twenty samples of meal from Humphreys, Godwin & Co., which contain less than six per cent.

of nitrogen. The five at and near the end of the tabulation of samples of meal sold by them have been further examined as follows:

No.	Nitrogen.	Ash.	Fiber.
165	4.87	4.83	17.13
192	5.30	5.91	13.46
193	5.27	5.46	13.49
212	4.94	4.91	17.39
228	5.34	5.56	13.90
Average good decorticated meal, 144 analyses	7.14	6.60	4.90
Average undecorticated meal	4.04	4.9	18.50

It is clear that these, and at least fifteen others, are not cotton seed meals as that term is understood in the trade,* but fine ground, undecorticated, or only partially decorticated, meal, all of them sold with a guaranty of 6.5 per cent., and running from one-half per cent. to more than one and one-half per cent. below this guaranty. Delivery of such meal ought to be refused, and the parties directly responsible for the fraud or "accident," that is, the manufacturers of it, should be prosecuted. If the commission houses who deal in such meal will not stop the fraud at its source, it will be necessary to hold them responsible under the federal and state laws.

The same observations also apply to at least six samples from Apothecaries Hall Company, four samples from the Buckeye Cotton Oil Co., and several from W. Newton Smith, which contained less than six per cent. of nitrogen, were far below their guaranties and were undecorticated meals. It should be said that the Humphreys-Godwin Co., when notified of the analysis of the meal referred to, promptly made a rebate to the purchaser, covering the deficiency in nitrogen.

Those who wish to have samples of meal examined at the station must bear in mind that proper sampling is no less import-

* According to the Commercial Fertilizer of July 12, 1912, the cotton oil trade at its annual association meeting adopted a definition of cotton seed meal and declared that nothing should be recognized, traded in, or sold as cotton seed meal which had less than 38 per cent. of protein. This is the equivalent of 6 per cent. of nitrogen.

ant than accurate analysis, and that careless sampling makes the analysis worse than useless. The seller will not and should not accept an analysis, unless he has proof that the sample was properly drawn. At least twenty bags should be opened in every car lot and about a pint taken from each, by thrusting the hand or a cup down into the meal. These samples should then be mixed carefully, and two samples drawn from the mixture, one to be sent to the station and the other held for the manufacturer in case it is called for. The one who samples should be prepared to make affidavit as to the date, number of car, number of bags opened, etc. The sample sent to the station should be fully described on a blank, which will be furnished on application.

This information should be given to the station before the analysis is undertaken, for the station has no right to do work with state funds unless it has some assurance that the work, when done, will be of value to the public. Frequently we receive samples with no marks to identify them, broken packages from which a part or all the sample has run out over the mail matter, samples quite too small to be representative, and samples not of stock delivered in the state, but of what some shipper *proposes* to supply. These, of course, are worthless, but they are not positively harmful, whereas a sample of meal on sale in the state, which is apparently all right, but has not been carefully drawn, may do great injustice either to buyer or seller.

CASTOR POMACE.

(Analyses on page 25.)

Castor pomace, a residue from the manufacture of castor oil, *and extremely poisonous to stock, which will eat it greedily if* they have the chance, is used more or less as a fertilizer for tobacco. Three samples have been examined:

Analyses of Cotton Seed Meal, 1912.

Station No.	Manufacturer or Jobber, Car No. or Marks.	Purchased, Sampled or Sent by	Per cent. of Nitrogen. Found.	Per cent. of Nitrogen. Guaranteed.	Cost per ton.	Nitrogen costs cents per pound.
	American Cotton Oil Co.					
334	....	P. Rogers........	6.49	6.50	$31.00	20.5
	Apothecaries Hall Co.					
85	11618........	Bissell-Graves Co........	6.06	6.25	26.00	17.8
111	24972........	" "	5.85	6.25	26.00	....
108	15348........	" "	5.72	6.25	26.00	....
86	32651........	" "	5.71	6.25	26.00	....
66	577819........	" "	5.64	....	26.00	....
110	35065........	" "	5.61	6.25	26.00	....
109	635........	" "	5.59	6.25	26.00	....
	Bainbridge Oil Co.					
97	....	Amer. Sumatra Tobacco Co........	6.62	....	30.00	19.3
96	....	" " "	6.56	....	30.00	19.5
98	....	" " "	6.56	....	30.00	19.5
100	....	" " "	6.50	....	30.00	19.7
99	....	" " "	6.46	....	30.00	19.8
	F. W. Brode and Co.					
190	23646........	Olds and Whipple........	7.03	6.58	31.00	18.9
150	70180........	" "	7.02	6.58	30.00	18.2
117	13068........	" "	7.01	6.58	30.00	18.2
127	17490........	" "	6.96	6.58	30.00	18.4
151	516465........	" "	6.95	6.58	30.00	18.4
609	79643........	Conn. Tobacco Corporation........	6.92	6.58	31.50	19.6
144	98237........	Olds and Whipple........	6.90	6.58	29.00	17.8
92	5833........	" "	6.88	6.58	30.00	18.6

ANALYSES OF COTTON SEED MEAL, [illegible].—Continued.

Station No.	Manufacturer or Jobber, Car No. or Marks.	Purchased, Sampled or Sent by	Per cent. of Nitrogen. Found.	Per cent. of Nitrogen. Guaranteed.	Cost per ton.	Nitrogen costs cents per pound.
161	10548	Olds and Whipple	6.86	6.58	$30.00	18.6
120	132319	" "	6.77	6.58	29.00	18.2
60	4667	" "	6.74	6.58	29.00	18.2
69	79873	" "	6.72	6.58	29.00	18.3
91	109227	" "	6.70	6.58	30.00	19.1
104	16458	" "	6.70	....	30.00	19.1
206	34003	" "	6.60	6.58	31.00	20.1
440		L. B. Haas and Co.	6.48	6.58	30.50	20.1
602	No. 2	Conn. Tobacco Corporation	6.40	6.58	30.50	20.4
601	12363 (No. 1)	" " "	6.35	6.58	30.50	20.5
413		" " "	6.18	....	30.50	21.1
	Buckeye Cotton Oil Co.					
594		J. E. Shepard	6.65	6.25	32.00	20.7
180	26955	Apothecaries Hall Co.	6.20	6.25	26.50	17.8
179	14167	G. S. Phelps	5.98	6.25	26.50	....
154	12869	A. E. Potwine	5.80	6.25	26.50	....
178	14380	Apothecaries Hall Co.	5.79	....	26.50	....
155	97337	A. E. Potwine	5.72	....	26.50	...
	T. H. Bunch Co.					
8	"Old Gold"	R. B. Eno	6.27	6.50	31.00	21.2
	S. P. Davis					
711		E. W. Woodward	6.86	6.50	32.50	20.5
232		A. W. Camp	6.57	6.50	32.00	21.0
	Farmers' Cotton Oil Co.					
211		F. B. Hatheway	6.34	6.25	28.20	18.8

Station No.	Manufacturer or Jobber, Car No. or Marks.	Purchased, Sampled or Sent by	Per cent. of Nitrogen.		Cost per ton.	Nitrogen costs cents per pound.
			Found.	Guaranteed.		
	Rodney J. Hardy and Sons.					
177	37703	Arthur Sikes and others	6.74	6.50	$30.50	19.4
189	137756	" " "	6.73	6.50	31.50	20.1
415	25770	" " "	6.69	....	32.50	21.0
416	31194	" " "	6.64	....	32.50	21.1
	Humphreys, Godwin and Co.					
6	37508	Olds and Whipple	7.60	7.70	35.00	20.1
158	136449	" "	6.88	6.99	32.00	20.0
353	Boat (W. No. 175)	" "	7.60	7.53	35.00	20.1
5	45201	" "	7.54	7.70	35.00	20.3
535	91597×73099	" "	7.36	....	35.00	20.8
573	Galveston	Spencer Bros., C. W. Bates	7.29	7.40	34.50	20.6
135	48666	Olds and Whipple	7.26	6.99	32.00	19.0
418	42581	" "	7.18	6.99	33.00	19.9
410	11742	L. C. Brainard and Co., J. E. Phelps	7.17	7.00	32.75	19.7
137	61879	C. F. Tilden	7.14	6.50	31.50	19.0
141	61879	L. C. Brainard and Co. and others	7.12	6.50	31.75	19.2
17	70373	Olds and Whipple	7.11	7.62	33.00	20.1
295	26528	" "	7.08	6.99	33.00	20.2
298	1746	" "	7.08	6.99	33.00	20.2
1	17580	" "	7.07	6.99	32.50	19.9
254	13616	" "	7.06	6.99	33.00	20.2
252	103789	" "	7.05	6.99	33.00	20.3
299	31232	" "	7.04	6.99	33.00	20.3
423	35606	" "	7.03	6.99	33.00	20.3
256	88205	" "	7.03	6.99	33.00	20.3
2	16813	" "	7.03	6.99	32.50	20.0
230	192441	" "	7.02	6.99	33.00	20.4
350	19022	" "	7.02	6.99	33.00	20.4
255	84859	" "	7.01	6.99	33.00	20.4

Analyses of Cotton Seed Meal, 1912.—*Continued.*

Station No.	Manufacturer or Jobber, Car No. or Marks.	Purchased, Sampled or Sent by	Per cent. of Nitrogen.		Cost per ton.	Nitrogen costs cents per pound.
			Found.	Guaranteed.		
16	9696	Olds and Whipple	7.00	7.62	$33.00	20.4
424	43195	" "	7.00	6.99	33.00	20.4
123	22052	" "	7.00	6.99	32.00	19.7
136	15679	" "	7.00	6.99	32.00	19.7
422	16257	" "	6.99	6.99	33.00	20.5
25	19925	" "	6.99	7.62	33.00	20.4
409	111408	L. C. Brainard and Co., J. E. Phelps	6.98	7.00	32.75	20.3
686	21175	Loomis Bros. Co.	6.98	6.50	30.25	18.5
15	14231	Olds and Whipple	6.98	7.62	33.00	20.5
14	92789	" "	6.97	7.20	33.50	20.9
84	52403	" "	6.97	6.99	32.50	21.4
143	15793	L. C. Brainard and Co.	6.96	6.50	30.50	18.7
251	2004	Loomis Bros. Co. and others	6.96	6.50	31.00	19.1
355	14862	Olds and Whipple	6.96	6.99	33.00	20.5
691	19544	" "	6.95	6.58	33.00	20.6
411	19423	L. C. Brainard and Co. and others	6.95	7.00	33.00	20.6
27	1647	Olds and Whipple	6.94	7.20	33.50	20.9
119	30615	" "	6.94	6.99	32.00	19.9
201	65655	Spencer Bros., G. A. Harmon	6.94	6.50	28.50	17.4
142	53413	L. C. Brainard and Co., O. Pitcher	6.92	7.00	32.15	20.0
10	11674	Olds and Whipple	6.92	7.20	33.50	21.0
420	97574	" "	6.92	6.99	33.00	20.7
494	98587	Spencer Bros., J. Sullivan	6.92	6.50	29.75	18.3
36	68393	Olds and Whipple	6.90	6.99	32.00	20.0
57	18930	" "	6.90	6.99	32.00	20.0
149	62814	" "	6.90	6.99	32.00	20.0
332	9081	" "	6.90	6.99	33.00	20.7
354	30001	" "	6.90	6.99	33.00	20.7
392	62176	Spencer Bros. and others	6.90	6.50	28.50	17.5
18	32330	Olds and Whipple	6.89	7.20	33.50	21.1

ANALYSES OF COTTON SEED MEAL, 1912.—*Continued.*

Station No.	Manufacturer or Jobber, Car No. or Marks.	Purchased, Sampled or Sent by	Per cent. of Nitrogen. Found.	Per cent. of Nitrogen. Guaranteed.	Cost per ton.	Nitrogen costs cents per pound.
351	6094	Olds and Whipple	6.89	6.99	$33.00	20.7
65	55032	*Spencer Bros. and others*	6.88	6.50	29.50	18.2
35	16611	Olds and Whipple	6.86	7.20	33.50	21.2
138	104756	Loomis Bros. Co. and others	6.85	6.50	30.25	19.0
250	25309	" " "	6.85	6.50	31.00	19.4
12	78377	Olds and Whipple	6.84	7.20	33.50	21.3
68	65292	" "	6.84	6.99	31.50	19.8
204	26	Spencer Bros. and others	6.82	6.50	30.50	19.1
37	94598	Olds and Whipple	6.81	6.99	32.00	20.3
52	13364	" "	6.80	6.99	31.50	19.9
690	106924	" "	6.80	6.58	33.00	21.0
685	86359	Loomis Bros. Co. and others	6.79	6.50	33.50	21.4
82	1645	" " "	6.79	....	32.00	20.3
64	17023	Spencer Bros. and others	6.78	6.50	28.50	17.8
32	109790	" " "	6.76	6.50	29.50	18.6
83	13991	*Loomis Bros.* Co. and others	6.76	6.50	30.25	19.1
118	83178	Olds and Whipple	6.75	6.99	32.00	20.4
62	11055	Spencer Bros., H. Adams	6.74	6.50	28.50	17.9
29	45563	Olds and Whipple	6.74	7.20	33.50	21.6
689	93188	" "	6.71	6.58	33.00	21.3
152	9816	Loomis Bros. Co.	6.68	6.50	31.00	19.9
405	131788	Spencer Bros., J. Sullivan	6.68	6.50	29.75	19.0
81	5244	Loomis Bros. Co. and others	6.66	....	32.00	20.7
403	60647	Spencer Bros. and others	6.66	6.50	29.50	18.8
324	140697	" " J. B. Rose	6.64	6.50	30.00	19.3
33	102400	" " M. Leahey	6.63	6.50	29.50	18.9
401	130510	" " and others	6.60	6.50	31.50	20.5
404	55488	" " J. Sullivan	6.58	6.50	29.75	19.2
301	107042	Olds and Whipple	6.57	6.78	30.00	19.5
333	....	P. J. Rogers	6.56	6.18	....	....

Analyses of Cotton Seed Meal, 1912.—*Continued.*

Station No.	Manufacturer or Jobber, Car No. or Marks.	Purchased, Sampled or Sent by	Per cent. of Nitrogen. Found.	Per cent. of Nitrogen. Guaranteed.	Cost per ton.	Nitrogen costs cents per pound.
197	38282	Olds and Whipple	6.55	6.58	$31.00	20.3
302	123108	" "	6.54	6.78	30.00	19.6
303	33193	" "	6.54	6.78	30.00	19.6
391	5322	Spencer Bros. and others	6.52	6.50	29.50	19.2
191	526955	Olds and Whipple	6.47	6.58	31.00	20.5
406	35357	Spencer Bros., J. Sullivan	6.46	6.50	29.75	19.6
687	11726	Olds and Whipple	6.45	6.58	33.00	22.2
600	2988	" "	6.45	6.58	29.00	19.1
305	10920	" "	6.44	6.78	30.00	19.9
408	81577	L. C. Brainard and Co., C. Chapin	6.41	6.50	32.50	21.9
407	31815	" " " G. A. Douglas	6.41	6.50	30.50	20.3
194	366	Olds and Whipple	6.39	6.58	31.00	20.8
7	....	Spencer Bros	6.37	6.40	27.00	17.7
496	32105	" " and others	6.35	6.50	29.50	19.8
492	45908	" " "	6.32	6.50	33.00	22.6
497	70145	" " "	6.32	6.50	32.50	22.2
210	27438	Olds and Whipple	6.32	6.58	31.50	21.4
326	729	Spencer Bros., D. Barron	6.32	6.50	28.50	19.1
172	40535	" " and others	6.30	6.50	28.50	19.1
163	104283	" " E. A. Fuller	6.30	6.50	28.50	19.1
168	8713 and 17509	" " and others	6.29	6.50	30.00	20.3
202	13296	" " " "	6.26	6.50	28.50	19.2
304	117134	Olds and Whipple	6.24	6.78	30.00	20.5
224	36749	" "	6.21	6.58	31.00	21.4
200	25815	Spencer Bros., Mrs. C. F. Whittemore	6.18	6.50	28.50	19.5
491	93475	" " and others	6.18	6.50	33.00	23.1
171	60961	" " C. C. Bissell	6.18	6.50	28.50	19.5
170	82767	" " and others	6.18	6.50	30.00	20.7
227	27669	J. F. Carroll	6.16	....	29.25	20.2
160	93823	Olds and Whipple	6.14	6.17	27.00	18.4

ANALYSES OF COTTON SEED MEAL, 1912.—*Continued.*

Station No.	Manufacturer or Jobber, Car No. or Marks.	Purchased, Sampled or Sent by	Per cent. of Nitrogen. Found.	Per cent. of Nitrogen. Guaranteed.	Cost per ton.	Nitrogen costs cents per pound.
169	6835 and 9591	Spencer Bros. and others	6.14	6.50	$30.50	21.2
400	88078	" " "	6.13	6.50	33.00	23.3
525	....	E. Halladay	6.07	6.18	33.00	23.5
173	81508	Spencer Bros. and others	6.02	6.50	30.00	21.2
495	20670	" " "	5.96	6.50	28.50	....
167	304372	" " "	5.96	6.50	30.00	....
162	87025	" " "	5.96	6.50	31.00	....
95	3232	" " "	5.95	6.50	30.00	....
115	79970	" " "	5.92	6.50	29.50	....
352	73999	Olds and Whipple	5.90	6.17	28.00	....
114	50935	Spencer Bros. and others	5.88	6.50	28.50	....
166	74533	" " "	5.79	6.50	30.50	....
174	4646	" " "	5.74	6.50	30.00	....
323	12848	" " D. Barron	5.66	6.50	28.50	....
402	13766	" " and others	5.64	6.50	29.50	....
493	83616	" " "	5.57	6.50	29.50	....
325	30508	" " "	5.54	6.50	30.50	....
159	87394	Olds and Whipple	5.52	6.17	27.00	....
229	33902	" "	5.38	6.58	29.00	....
228	191809	" " Keiser and Boasberg Co.	5.34	6.58	29.00	....
192	29438	" " Windsor Tob. Grow. Corp.	5.30	6.58	29.00	....
193	89824	" "	5.27	6.58	29.00	....
212	44219	Spencer Bros	4.94	6.50	30.00	....
165	44219	" " and others	4.87	6.50	30.00	....
	Olds and Whipple.					
357	....	C. A. Huntington	7.60	7.40	33.50	19.1
635	....	C. W. Porter	7.20	....	32.50	19.5
716	84321	Conn. Tobacco Corp.	7.08	6.58	31.00	18.8
717	62557	" " "	6.96	6.58	31.00	19.1

Analyses of Cotton Seed Meal, 1912.—*Continued.*

Station No.	Manufacturer or Jobber, Car No. or Marks.	Purchased, Sampled or Sent by	Per cent. of Nitrogen. Found.	Per cent. of Nitrogen. Guaranteed.	Cost per ton.	Nitrogen costs cents per pound.
838	25798	Griffin-Neuberger Tobacco Co., Clarksville	6.95	6.50	$31.50	19.5
833	40318	" " " "	6.92	6.50	31.50	19.6
603	13032	Conn. Tobacco Corp., Clarksville	6.94	6.58	31.50	19.6
607	37564	" " " "	6.86	6.68	31.50	19.7
604	84050	" " " "	6.77	6.58	31.50	20.0
836	21164	Griffin-Neuberger Tobacco Co., Clarksville	6.72	6.50	31.50	20.2
441		O'Connor-Haviland Tobacco Co.	6.64	....	31.00	20.0
835	24638	Griffin-Neuberger Tobacco Co., Clarksville	6.61	6.50	31.50	20.5
714	58203	Conn. Tobacco Corp.	6.59	6.58	31.00	20.2
834	31201	Griffin-Neuberger Tobacco Co., Clarksville	6.58	6.50	31.50	20.6
608	78460	Conn. Tobacco Corp.	6.36	6.58	31.50	21.3
606	93185	" " "	6.32	6.58	31.50	21.4
715	4832	" " "	6.30	6.58	31.00	21.1
837	36593	Griffin-Neuberger Tobacco Co., Clarksville	6.22	6.50	31.50	21.8
605	44445	Conn. Tobacco Corp.	6.18	6.58	31.50	21.9
	Quitman Oil Co.					
486		Amer. Sumatra Tobacco Co.	6.51	6.18	31.00	20.4
	D. W. Ranlet Co.					
176	8617	Arthur Sikes and others	6.73	6.50	30.50	19.4
	W. Newton Smith.					
576	70354	Olds and Whipple	7.20	....	33.00	19.8
399	46065	Spencer Bros., J. Davis	7.14	6.50	32.50	19.7
572	86715	" " and others	7.12	6.50	33.50	20.4
575	132146	Olds and Whipple	7.10	....	33.00	20.1
395	52044	Spencer Bros. and others	7.06	6.50	31.00	18.8
598	32567	Olds and Whipple	7.05	6.58	32.50	20.0
634	36874	" "	7.05	....	34.00	21.0

Analyses of Cotton Seed Meal, 1912.—*Continued.*

Station No.	Manufacturer or Jobber, Car No. or Marks.	Purchased, Sampled or Sent by	Per cent. of Nitrogen. Found.	Per cent. of Nitrogen. Guaranteed.	Cost per ton.	Nitrogen costs cents per pound.
485	14055	Arthur Sikes	7.02	....	$31.75	19.5
571	86559	Spencer Bros. and others	7.02	6.50	33.50	20.7
523	.....	Conn. Tobacco Corp.	6.96	....	.....	....
199	25179	Olds and Whipple	6.96	6.58	31.00	19.1
522	89580	" "	6.95	6.58	32.50	20.2
175	103100	Spencer Bros. and others	6.90	6.50	31.50	19.6
63	75275	" " "	6.90	6.50	30.50	18.9
67	4452	Olds and Whipple	6.86	6.58	30.00	18.6
93	35392	Spencer Bros. and others	6.85	6.50	30.00	18.7
94	65858	" " "	6.85	6.50	30.00	18.7
757	92075	Olds and Whipple	6.85	6.58	33.00	20.9
741	140356	" "	6.84	6.58	33.00	20.9
296	130836	" "	6.82	6.58	31.50	19.8
707	101230	" "	6.82	6.58	33.00	21.0
758	89524	" "	6.80	6.58	33.00	21.0
718	24476	" "	6.80	6.58	33.00	21.0
61	17131	" "	6.78	6.58	30.00	18.9
51	8506	" "	6.77	6.58	30.00	18.9
688	310417	" "	6.76	6.58	33.00	21.1
414	60504	Arthur Sikes and others	6.76	6.50	32.50	20.8
34	93628	Spencer Bros. and others	6.75	6.50	30.00	18.9
595	33935	Olds and Whipple	6.75	6.58	32.50	20.8
790	70654	" "	6.75	6.58	33.00	21.2
425	7881	Arthur Sikes and others	6.72	6.50	33.50	21.6
740	109216	Olds and Whipple	6.72	6.58	33.00	21.3
710	72146	" "	6.72	6.58	33.00	21.3
297	137470	" "	6.70	6.58	31.00	19.8
58	8740	" "	6.68	6.58	30.50	19.5
356	12906	" "	6.65	6.58	32.00	20.7

Analyses of Cotton Seed Meal, 1912.—*Continued.*

Station No.	Manufacturer or Jobber, Car No. or Marks.	Purchased, Sampled or Sent by	Per cent. of Nitrogen.		Cost per ton.	Nitrogen costs cents per pound.
			Found.	Guaranteed.		
613	30128	Olds and Whipple	6.65	6.58	$33.00	21.5
198	12304	" "	6.64	6.58	31.00	20.0
719	66220	" "	6.63	6.58	33.00	21.5
112	8223	" "	6.63	6.58	30.00	19.3
113	88734	Spencer Bros. and others	6.63	6.50	31.50	20.4
397	3473	" " "	6.62	6.50	31.50	20.5
103	24302	Olds and Whipple	6.61	6.58	30.00	19.3
223	114176	" "	6.60	6.58	31.00	20.1
739	136510	" "	6.60	6.58	33.00	21.6
331	14141 and 10607	" "	6.60	6.58	32.00	20.9
164	18068 and 63780	Spencer Bros. and others	6.59	6.50	31.00	20.2
203	32323	" " "	6.58	6.50	31.50	20.6
708	94473	Olds and Whipple	6.58	6.58	33.00	21.7
398	65490	Spencer Bros. and others	6.56	6.50	31.50	20.6
253	20972	Olds and Whipple	6.56	6.58	31.50	20.6
692	73624	" "	6.55	6.58	33.00	21.8
231	36507 and 24602	" "	6.54	6.58	31.50	20.7
396	92705	Spencer Bros. and others	6.52	6.50	31.50	20.8
393	86589	" " "	6.52	6.50	32.50	21.5
207	29995	Olds and Whipple	6.51	....	31.50	20.8
489	78503	" "	6.51	6.58	32.50	21.6
709	81364	" "	6.51	6.58	33.00	22.0
209	20785	" "	6.50	6.58	31.50	20.8
330	3438	" "	6.50	6.58	32.00	21.2
610	30573	" "	6.49	6.58	33.00	22.0
116	16456 and 133946	Spencer Bros. and others	6.49	6.50	30.00	19.7
249	55196	" " G. A. Peckham	6.48	6.50	31.50	20.9
534	32604	Olds and Whipple	6.48	6.58	32.50	21.7
596	7773	" "	6.47	6.58	32.50	21.7
611	38227	" "	6.46	6.58	33.00	22.1

Analyses of Cotton Seed Meal, 1912.—*Concluded.*

[illegible] No.	Manufacturer or Jobber, Car No. or Marks.	Purchased, Sampled or Sent by	Per cent. of Nitrogen. Found.	Per cent. of Nitrogen. Guaranteed.	Cost per ton.	Nitrogen costs cents per pound.
17	8550	Arthur Sikes, E. S. Seymour	6.45	....	$31.75	21.2
94	49637	Spencer Bros. and others	6.44	6.50	32.50	21.8
48	35367	" " "	6.44	6.50	32.50	21.8
27	78906 and 3957	" "	6.43	6.50	31.50	21.1
08	116333	Olds and Whipple	6.40	6.58	31.50	21.2
74	35527	" "	6.39	....	33.00	22.4
06	94270	" "	6.38	6.58	33.00	22.4
12	30070	" "	6.36	6.58	33.00	22.5
00	2891	" "	6.35	6.58	31.50	21.3
88	9611	" "	6.34	6.58	32.50	22.1
14	20196	" "	6.32	6.58	33.00	22.6
99	20025	" "	6.30	6.58	32.50	22.3
90	93823	" "	6.25	6.58	32.50	22.5
87	1722	" "	6.20	6.58	32.00	22.2
97	44496	" "	6.20	6.58	32.50	22.6
19	67097	" "	6.18	6.58	31.50	21.9
57	14293	" "	5.97	6.58	30.00	....
21	26443	" "	5.97	6.58	31.50	....
12	67097	" " J. B. Parker	5.90	6.58	34.50	....
	J. E. Soper Co.					
33	....	C. H. Dexter & Sons	6.58	6.50	32.00	21.0
47	....	" " "	6.34	6.50	32.00	21.8
30	....	" " " T. J. Coleman	6.10	6.00	29.00	20.1
	Jobber Unknown.					
23	....	Conn. Tobacco Corp.	6.96	....	.....	....
96	....	C. H. Dexter and Sons	6.06	....	32.00	22.8

245. Gray Pomace. Stock of Olds & Whipple, Hartford.

526. Sold by American Agricultural Chemical Co., New York. Stock of Seth Viets, West Suffield.

236. Sold by Baker Castor Oil Co., New York. Stock of Olds & Whipple, Hartford.

ANALYSES.

Station No.	245	526	236
Percentage amounts of			
Nitrogen, as ammonia	0.02	0.00	0.02
" organic, water-soluble	0.52	0.62	0.76
" " active insoluble	2.40	....	1.90
" " inactive insoluble	2.22	....	1.77
Total nitrogen	5.16	4.46	4.45
" phosphoric acid	1.84	....	1.65
" potash	1.07	....	0.97
Cost per ton	$25.00	25.00	25.00
Nitrogen cost cents per pound	**21.8**	**25.8**	**25.5**

The gray pomace contains over half a per cent. more of nitrogen than the others and at the same price is a more economical purchase. Castor pomace is the most expensive form of nitrogen at present used as a fertilizer on tobacco lands.

LINSEED MEAL.

A single sample, **484**, sent by W. M. Hinson, Hazardville, contained 5.34 per cent. of nitrogen. The five years tests made by this Station at Poquonock showed that linseed meal was an excellent source of nitrogen in tobacco fertilizers.

To make it worth consideration as a substitute for cotton seed meal it would have to be bought for about $24.00 per ton, far below its present price.

II. RAW MATERIALS CHIEFLY VALUABLE FOR PHOSPHORIC ACID.

GROUND PHOSPHATE ROCK.

216. Mt. Pleasant Tennessee Ground Phosphate Rock. This sample contained 25.43 per cent. of phosphoric acid.

Price $3.00 bulk or $4.00 in burlap bags, in car lots, f. o. b. Mt. Pleasant. Freight to New Haven, about $4.80.

At these prices phosphoric acid costs delivered in car lots in this state, about 1½ to 1¾ cents per pound.

637. Tennessee Phosphate, made by Central Phosphate Co., Mt. Pleasant, Tenn., sold by Apothecaries Hall Co., Waterbury, contains 25.80 per cent. of phosphoric acid and costs $12.00 per ton, making the cost of phosphoric acid 2.3 cents per pound.

898. Tennessee Phosphate, bought of John Ruhm, Jr., Mt. Pleasant, Tenn., by W. A. Henry & Son, Wallingford, contained 28.75 per cent. of phosphoric acid. 75 per cent. of the phosphate passed a 100 mesh sieve.

Car lots of Tennessee fine ground rock phosphate have been offered, delivered in Connecticut, in paper lined cars, for $7.60 per ton with a guaranty of 29¾ per cent. of phosphoric acid. This would be equal to a price of 1¼ cents per pound of phosphoric acid.

There seems to be no difficulty in shipping ground rock in bulk in a paper-lined car. Thirty tons fills an ordinary car to a depth of eighteen inches to two feet.

BASIC SLAG OR THOMAS PHOSPHATE POWDER.

This material is a finely ground slag produced by a special process of removing phosphorus from iron.

It contains from 17 to 19 per cent. of phosphoric acid, 35 to 50 per cent. of lime, 13 or more per cent. of iron and smaller quantities of magnesia and manganese.

Very little of the phosphoric acid is soluble in water, but by a conventional method of extraction (Wagner's method) the larger part of the phosphoric acid in slag of good quality is soluble in ammonium citrate. Pot and field experiments and practical experience have alike shown that the phosphoric acid of basic slag is quite readily available to crops and it has come into rather extensive use, particularly by orchardists.

Last year some basic slag of quite inferior composition was sold in this State, and in order to more certainly determine the quality of this year's purchases the fineness of all samples has been determined with standard sieves and the citrate-soluble phosphoric acid has been determined by the Wagner method.

The samples are as follows:

180. Sold by the Coe-Mortimer Co. Sampled and sent by F. H. Beers, Brookfield Centre.

153. Sold by American Agricultural Chemical Co. to E. Manchester's Sons. Sampled and sent by C. R. Newton, Woodbridge.

222. Sold by Fertilizer Materials Supply Co. to the Agricultural Station.

234. Sold by American Agricultural Chemical Co. Stock of F. S. Platt Co., New Haven.

241. Sold by the Coe-Mortimer Co. Stock of Lightbourn & Pond Co., New Haven.

243. Sold by Fertilizer Materials Supply Co. Stock of L. M. Benham, Highwood.

244. Sold by American Agricultural Chemical Co. Stock of Thos. Griswold & Son, South Wethersfield.

246. Sold by Ross Bros., Worcester. Stock of Olds & Whipple, Hartford.

257. Sold by Fertilizer Materials Supply Co. Sampled and sent by A. E. Plant, Branford.

279. Sold by American Agricultural Chemical Co. to E. Manchester's Sons. Sampled and sent by John Gotta, Portland.

364. Sold by Nitrate Agencies Co. Stock of J. F. Merrell, Suffield.

446. Sold by Wilcox Fertilizer Co., Mystic. Sampled at factory.

543. Sold by Sanderson Fertilizer and Chemical Co. Stock of S. L. Tuttle, Wallingford.

577. Sold by Apothecaries Hall Co., Waterbury. Sampled from their stock.

The table of analyses of basic slag shows:

1. The mechanical condition of all the samples is very satisfactory and quite uniform; about 60 per cent., by weight, is finer than a 200 mesh and only about 5 1-2 per cent. coarser than 50 mesh.

2. The per cent. of phosphoric acid ranges from 16.61 to 19.80, the average being 17.59.

3. The "citrate-soluble" phosphoric acid, excluding four samples, ranges from 14.71 to 16.84 and averages 15.57.

4. Four samples, all of them from the American Agricultural Chemical Co., contain respectively 13.65, 12.64, 13.42 and 10.07 per cent. of citrate-soluble phosphoric acid, being much below the average of all the others. The goods represented by these four samples were, however, bought and sold on a guaranty of 17 per cent. total and 11.9 soluble by the Wagner method and therefore practically met their guaranty.

5. The retail cost of phosphoric acid in basic slag has been about 4.6 cents per pound. It has been bought by farmers in mixed car lots for from 3.6 to 4.3 cents.

ANALYSES OF BASIC SLAG.

(Percentage Amounts)

	Mechanical Analysis.									Phosphoric Acid.			
	Coarser than 10.	10 to 20.	20 to 30.	30 to 40.	40 to 50.	50 to 80.	80 to 100.	100 to 200.	Finer than 200.	Total.	"Available" Wagner Method.	Insoluble.	Cost per ton.
0	...	1	1	3	3	12	8	14	58	19.80	16.84	2.96	$18.0
3	...	1	1	1	1	9	2	18	67	17.91	13.65	4.26	15.0
2	...	...	1	1	2	15	5	20	56	17.07	15.07	2.00	.....
4	...	2	1	1	1	8	4	21	62	17.65	12.64	5.01	17.5
1	...	1	1	2	3	12	5	19	57	18.41	15.75	2.66	17.0
3	...	...	1	2	3	14	4	19	57	16.98	15.24	1.74	.....
4	...	1	...	1	1	7	4	21	65	18.12	13.42	4.70	15.0
5	...	1	1	1	1	10	5	20	61	18.50	16.03	2.47	17.00
7	...	...	2	3	4	15	4	20	52	16.93	14.71	2.22	15.00
9	1	3	3	2	1	6	3	17	64	16.29	10.07	6.22	.....
4	...	1	...	1	1	10	4	19	64	17.71	15.95	1.76	16.00
5	...	...	1	2	3	14	4	19	57	16.61	15.53	1.08	16.0
3	...	1	1	1	1	14	6	21	55	17.05	15.38	1.67	.....
7	...	...	1	1	2	12	5	20	59	17.26	15.20	2.06	18.00
erages,	0	1	1	1.5	2	11	4.5	19	60	17.59	14.68	2.91	
erage, excluding Nos. 153, 234, 244 and 279										17.63	15.57		

PRECIPITATED BONE.

This material, understood to be a by-product of glue manufacture, is a fine, dry, white powder, neutral in reaction and having the composition given below:

It is used chiefly as a tobacco fertilizer.

260. Sampled and sent by Olds & Whipple, Hartford.

11. Sent by the American Agricultural Chemical Co.

261. Sampled and sent by the Keiser & Boasberg Plantation from stock bought of Olds & Whipple.

ANALYSES OF PRECIPITATED BONE.

	260	11	261
Water-soluble phosphoric acid	0.94	35.81	0.80
Citrate-soluble phosphoric acid	37.71		37.71
Citrate-insoluble phosphoric acid	0.13	1.73	0.09
Total phosphoric acid	38.78	37.54	38.60

This material has over 37 per cent. of "available" phosphoric acid and sells at a price which makes the cost of "available" phosphoric acid about 5 cents per pound in mixed car lots.

DISSOLVED ROCK PHOSPHATE OR ACID PHOSPHATE.

This material is made by treating mineral phosphates or phosphate rock with oil of vitriol (sulphuric acid), which makes the phosphates largely soluble in water.

The guaranty gives the percentage of "available" phosphoric acid. This is a purely trade name for the sum of the water-soluble and citrate-soluble phosphoric acid. It has no reference to the actual availability of the phosphoric acid to crops. In the case of well-made acid phosphates, however, having domestic rock phosphates as a base, it is fair to assume that the greater part of the "available" phosphoric acid as defined above is actually readily available to crops.

The following analyses show the average composition of this material:

445. Stock of Wilcox Fertilizer Co., Mystic.

444. Sold by Nitrate Agencies Co., New York. Stock of J. F. Merrell, Suffield.

268. Sold by the American Agricultural Chemical Co., New York. Stocks of F. S. Platt Co., New Haven, and Apothecaries Hall Co., Waterbury.

581. Sold by F. S. Royster Guano Co., Baltimore. Stock of Wells & Downs, Killingly.

737. "High Grade Soluble Phosphate," sold by Coe-Mortimer Co. Stock of Spencer Bros., Suffield.

442. Sold by Bowker Fertilizer Co. Stocks of A. D. Bridge's Sons, Hazardville, and S. B. Wakeman, Saugatuck.

443. Sold by L. T. Frisbie Co., New Haven. Stock of Lightbourn & Pond, New Haven.

225. Sold by Fertilizer Materials Supply Co., New York. Stock of L. M. Benham, Andrew Ure and S. A. Flight, Highwood.

183 and **239.** Sold by Sanderson Fertilizer & Chemical Co., New Haven. **183** from stock of Connecticut School for Boys, Meriden. **239** from stock of C. R. Treat, Orange.

The table of analyses shows one sample, **443**, of lower grade than the others, guaranteed 12.0 per cent. available and selling at

Analyses of Acid Phosphate.

Station No.	445	444	268	581	737	442	443	225	183	239
Percentage amount of										
Water-soluble phosphoric acid	13.96	12.88	11.27	11.54	11.50	10.04	8.79	13.50	9.49	12.99
Citrate-soluble phosphoric acid	1.41	3.05	3.88	4.37	3.38	3.76	2.56	1.57	4.68	1.80
Citrate-insoluble phosphoric acid	1.20	1.29	1.08	0.26	1.18	1.47	0.82	0.74	1.53	1.45
Total phosphoric acid	16.57	17.22	16.23	16.17	16.06	15.27	12.17	15.81	15.70	16.24
Sum of water-soluble and citrate-soluble phosphoric acid found	15.37	15.93	15.15	15.91	14.88	13.80	11.35	15.07	14.17	14.79
"Available" phosphoric acid guaranteed	15.0	14.0	14.0	16.0	14.0	14.0	12.0	14.0	14.0	14.0
Cost per ton	$15.00	16.00	15.50	17.75	16.50	16.00	14.50	....	....	.....
"Available" phosphoric acid costs cents per pound	4.9	5.0	5.1	5.6	5.6	5.8	6.4	....	....	.....

a lower price; but available phosphoric acid costs more in that than in any other. Only very rarely are low grades with low prices really economical to buy.

The cost of "available" phosphoric acid at retail has ranged from 4.9 to 6.4 cents per pound. In mixed car lots farmers have bought it at much lower prices, ranging from 3.6 to 4.4 cents per pound.

III. RAW MATERIALS OF HIGH GRADE CONTAINING POTASH.

HIGH-GRADE SULPHATE OF POTASH.

(Analyses on page 33.)

This chemical should contain about 90 per cent. of pure potassium sulphate (sulphate of potash), equivalent to about 49 per cent. of potassium oxide ("potash"), and it should be nearly free from chlorides. The nine samples analyzed were of good quality and, with one exception, met their guaranties.

This exception may be apparent rather than real. On page 9 we have noted that an over-weight of the package, caused by its drawing moisture, will cause a lowering of *percentage* composition without affecting the total amount of plant food in the bag. A slight increase in weight makes a large difference in the percentage composition of very high-grade goods like potash salts.

Thus, if a bag weighing 220 pounds net and containing 50 per cent. of potash absorbs 2 pounds of moisture, it will contain, of course, as much potash as it did before, but the *percentage* of potash will be only 49.55.

The same holds true for all the potash salts.

The ruling price of high-grade sulphate at retail, delivered, has been from $48 to $51 per ton, making the cost of actual potash in this form about 5 cents per pound.

DOUBLE MANURE SALT.

(Analyses on page 33.)

This material is frequently sold on a guaranty of "48-50 per cent. sulphate," which is equivalent to 25.9-27.0 per cent. of potassium oxide (actual potash). Besides some 46-50 per cent. of potassium sulphate, it contains over 30 per cent. of magnesium sulphate, chlorine equivalent to 3 per cent. of common salt, a

little sodium and calcium sulphates, and varying quantities of moisture.

The two samples analyzed were of average composition.

The cost of potash per pound in double manure salt was 6.1 cents, higher than in high-grade sulphate. In mixed car lots it was bought for 4.9 cents.

MURIATE OF POTASH.

(ANALYSES ON PAGES 33 AND 34.)

Commercial muriate of potash contains about 80 per cent. of muriate of potash (potassium chloride), equivalent to 50.5 per cent. of actual potash, 15 per cent. or more of common salt and 4 per cent. or more of water.

The fourteen samples were of average composition with the exception of **240** which contained an exceptionally high percentage of potash.

The average cost per pound of potash in the mnriate was 4.25 cents. In mixed car lots it has been bought for from 3.6 to 3.9 cents per pound.

Sample **481** contained 49.09 per cent. of potash and 50 per cent. is guaranteed.

Two bags weighed respectively 208 and 210 pounds, an average of 209 pounds. Allowing 2 pounds for the bag these bags contained 207 instead of 200 pounds, the marked weight. Now 207 pounds with 49.09 per cent. contain 101.6 pounds of actual potash, whereas 200 pounds with 50 per cent. contain 100 pounds.

This illustrates again the fact that this kind of material may absorb enough water to reduce the *percentage* below guaranty and yet may contain the full *number of pounds* of actual potash which has been guaranteed.

KAINIT.

(ANALYSES ON PAGE 34.)

Kainit contains from 11 to 15 per cent. of potash, more than that quantity of soda, and rather less magnesia. These "bases" are combined with chlorine and sulphuric acid. It usually contains more water than either the sulphate or muriate of potash and is sold on a guaranty of from 12 to 15 per cent. of potash.

Only three samples were examined, which are of average composition.

Station No.		Sampled and sent by	Potash soluble in water.		Cost per ton.	Potash costs cents per pound.
			Found.	Guaranteed.		
	High-Grade Sulphate of Potash.					
271	Thos. Griswold, So. Wethersfield, from Coe-Mortimer Co.	Station Agent	49.86	48.0	$48.00	4.8
390	E. C. Hills, Southwick, Mass., from Amer. Agr. Chem. Co.	Purchaser	51.37	48.0	51.00	5.0
531	Wilcox Fertilizer Co., Mystic	Station Agent	51.45	48.0	51.00	5.0
537	Rogers Mfg. Co., Rockfall	Station Agent	50.24	48.0	50.00	5.0
641	C. E. Kempton, Pomfret Center, from F. S. Royster Guano Co., Baltimore	Station Agent	49.73	48.0	51.00	5.1
362	J. F. Merrell, Suffield, from Nitrate Agencies Co.	Station Agent	47.64	48.0	50.00	5.2
482	S. B. Wakeman, Saugatuck, from German Kali Works, Baltimore	Station Agent	48.22	48.0	50.00	5.2
267	Apothecaries Hall Co., Waterbury, from Amer. Agr. Chem. Co.	Station Agent	49.88	48.0	58.00	5.8
542	S. L. Tuttle, Wallingford, from Sanderson Fert. and Chem. Co.	Station Agent	49.12	48.6	.....	....
	Double Sulphate of Potash and Magnesia.					
359	Edmund Halladay, Suffield, from Amer. Agr. Chem. Co.	Station Agent	25.56	26.0	31.00	6.1
185	Conn. School for Boys, Meriden, from Sanderson Fert. and Chem. Co.	Station Agent	27.30	26.0	.....	....
	Muriate of Potash.					
258	A. E. Plant, Branford, from Fertilizer Materials Supply Co.	Purchaser	51.57	50.0	40.00	3.9
280	John Gotta, Portland, from E. Manchester and Sons, Winsted	Purchaser	51.56	49.0	40.40	3.9

POTASH SALTS. PERCENTAGE COMPOSITION AND COST PER POUND OF POTASH.—*Continued.*

		Sampled and sent by	Potash soluble in water. Found.	Potash soluble in water. Guaranteed.	Cost per ton.	Potash costs cents per pound.
365	J. F. Merrell, Suffield, from Nitrate Agencies Co.	Station Agent	51.56	50.0	$41.00	4.0
532	Wilcox Fertilizer Co., Mystic	Station Agent	52.16	50.0	43.00	4.1
538	Rogers Mfg. Co., Rockfall	Station Agent	51.32	48.0	42.00	4.1
481	S. B. Wakeman, Saugatuck, from German Kali Works, Baltimore	Station Agent	49.09	50.0	41.00	4.2
639	W. S. Morris, Wethersfield and L. A. Gowdy, Somersville, from Coe-Mortimer Co.	Station Agent	50.64	49.0	43.00	4.2
269	F. S. Platt Co., New Haven, from Am. Ag. Chem. Co.	Station Agent	51.42	50.0	44.50	4.3
132	F. S. Platt Co., New Haven, from Am. Ag. Chem. Co.	Purchaser	50.54	50.0	44.50	4.4
273	Lightbourn & Pond Co., New Haven, from L. T. Frisbie Co.	Station Agent	50.53	50.0	46.00	4.6
361	A. D. Bridge's Sons, Hazardville, from Bowker Fertilizer Co.	Station Agent	50.92	49.0	48.00	4.7
184	Conn. School for Boys, Meriden, from Sanderson Fert. and Chem. Co.	Station Agent	49.34	49.0	.....	....
240	C. R. Treat, Orange, from Sanderson Fert. & C. Co.	Station Agent	54.34	49.0	.....	....
262	E. B. Sniffen, Stratford, from Sanderson Fert. & C. Co.	Purchaser	49.18	....	.....	....
	Kainit.					
186	Conn. School for Boys, Meriden, from Sanderson Fert. and Chem. Co.	Station Agent	14.08	12.0	.....	....
536	L. J. Phelps, Colebrook, from German Kali Works, Baltimore	Station Agent	13.35	12.0	.....	....
736	A. S. Stowe, Bethel, from Amer. Agr. Chem. Co.	Station Agent	11.92	12.0	.....	....

VEGETABLE POTASH.

This material, which is understood to be a residue from the beet sugar manufacture, is considerably used as a tobacco fertilizer, most of its potash being in form of carbonate.

A single sample, **738**, from stock of Olds & Whipple, Hartford, had the following composition:

Percentage amounts of	
Potash calculated as muriate	1.53
Potash calculated as sulphate	1.59
Potash calculated as carbonate	23.32
Total water-soluble potash found	26.44
Guaranteed	25.00
Cost per ton	$43.00
Potash costs cents per pound	**8.1**

COTTON BOLL AND COTTON HULL ASHES.

Eight samples of this material, rightly prized as a potash fertilizer on tobacco lands, have been analyzed, as follows:

791. Of light color, sent by L. B. Haas & Co., Hartford.

13. Bought of the Oil Seeds Co., by E. N. Austin, Suffield.

636. Bought of Olds & Whipple, Hartford, by C. W. Porter, Hockanum.

870. Bought of American Cotton Oil Co., by Spencer Bros., Suffield.

887. Bought of American Cotton Oil Co., by Spencer Bros., Suffield.

792. Part of the same shipment as **791**, but darker in color. This sample contained 16.37 per cent. of sand and soil and 11.40 per cent. of coal.

483. Sent by W. M. Hinson, Hazardville.

105. Sent by Huntington Bros., Windsor.

ANALYSES OF COTTON HULL AND COTTON BOLL ASHES.

Station No.	791	13	636	870	887	792	483	105
Percentage amounts of								
Water-soluble potash	22.08	23.40	26.62	21.32	20.82	14.88	23.38	23.3
Cost per ton	$36.00	40.00	55.00	*	*	36.00	.....	....
Potash costs cents per pound	**8.2**	**8.6**	**10.3**	**11.2**	**11.2**	**12.1**	.....	....

* $2.25 per unit.

The analyses of **791** and **792** show the great inequalities in composition of different packages in the same shipment.

Potash in this form of carbonate has cost from 8.2 to 12.1 cents per pound.

IV. RAW MATERIALS CHIEFLY VALUABLE FOR NITROGEN AND PHOSPHORIC ACID.

FISH MANURES.

"Fish Scrap," or Dry Ground Fish, as it has been sold in this state for many years, is the dried and ground residue left after expressing the oil from porgies or menhaden. It usually contains 8 per cent. or more of nitrogen and about 7 of phosphoric acid.

Of late there has come into market "dry ground fish" of very different origin and composition from what was previously sold under that name in this state. It is a by-product of factories where fish is prepared for market and does not consist chiefly of the flesh of the fish but is the refuse from the factory, and has considerably less nitrogen and much more phosphoric acid than the dry ground fish from the menhaden oil factories. It contains about 6½ per cent. of nitrogen and 18.00 to 19.00 per cent. of phosphoric acid.

Samples **476**, **156** and **205** represent this material. Four of the fourteen fish manures analyzed do not fully meet their guaranties of nitrogen.

If we allow 3 2-3 cents per pound for the phosphoric acid, the nitrogen in the fish manures costs from 20.3 to 29.1 cents (with one exception, 869, the upper limit is 24.3 cents), and the average of all is 23.4 cents.

No. **474** had less nitrogen than guaranteed. The two single samples from which this sample is made up contained the same percentage, and the manufacturer's chemist in our sample found substantially the same percentage that the Station found.

A second sample, **869**, of this same brand shows a still lower percentage of nitrogen.

SLAUGHTER HOUSE TANKAGE.

(ANALYSES ON PAGES 38 AND 39.)

After boiling or steaming various slaughter-house wastes, fat rises to the surface and is removed, the soup is run off and the settlings remaining in the tanks ("tankage") is dried, ground and sold as a fertilizer.

Manufacturer and Dealer.	Nitrogen.						Phosphoric Acid.					Cost per ton.	Valuation per ton.	Percentage difference between co and valuation.
	As Ammonia.	Water-Soluble Organic.	Active Insoluble Organic.	Inactive Insoluble Organic.	Total found.	Total guaranteed.	Water-soluble.	Citrate-soluble.	Citrate-insoluble.	Total found.	Total guaranteed.			
FISH MANURES, SAMPLED BY STATION.														
nerican Agr. Chem. Co. Stock of F. J. Hartz, Burnside, and Morris Sullivan, East Windsor Hill	0.44	0.98	4.18	2.23	7.83	8.23	0.56	5.10	2.80	8.46	6.0	$44.25	$39.66	11.6
nerican Agr. Chem. Co. Stock of Broad Brook Lumber Co	0.70	*	6.21	*	6.91	8.23	0.81	5.02	1.94	7.77	6.0	46.00	35.16	30.8
owker Fertilizer Co. Stock of C. F. Brewer, Silver Lane, T. J. Coleman, Warehouse Point	0.62	1.15	4.15	2.20	8.12	8.23	0.70	5.57	1.29	7.56	6.0	44.50	40.66	9.4
oe-Mortimer Co. Stock of J. N. Lasbury, Broad Brook	0.12	0.74	3.91	1.49	6.26	6.59	0.40	10.06	9.06	19.52	...	36.00	39.45	8.7†
lantic Menhaden Oil & Guano Co. Stock of F. S. Bidwell & Co., Windsor Locks, and Spencer Bros., Suffield	0.76	2.58	2.99	2.29	8.62	8.25	1.16	4.34	0.97	6.47	6.0	45.00	41.99	7.1
ids & Whipple, sampled from dealer's stock	1.25	1.65	4.79	2.06	9.75	8.20	2.18	4.60	0.59	7.37	6.0	45.00	47.41	5.1†
nderson Fertzr. & Chem. Co. Stock of C. M. Smith, East Hartford	0.44	1.08	3.67	2.86	8.05	8.2	0.39	4.96	1.42	6.77	6.0	40.85	39.82	2.6
ilcox Fertilizer Co. Sampled at factory	0.18	0.45	6.47	2.20	9.30	8.0	0.51	4.30	1.66	6.47	6.0	44.00	45.28	2.8†
cidulated Fish, Wilcox Fertilizer Co. Sampled at factory	0.80	1.94	2.61	2.79	8.14	7.8	1.42	4.39	0.87	6.68	5.0	41.00	40.08	2.6
cidulated Fish Guano. Niantic Menhaden Oil & Guano Co. Stock of W. W. Gates, Moodus	0.75	0.70	2.09	1.04	4.58	3.3	0.40	3.65	1.25	5.30	3.5	27.00	23.11	16.8
sh Tankage, C. M. Shay Fertilizer Co. Stock of Andrew Ure, Highwood	0.33	3.07	2.03	1.31	6.74	...	...	...	...	9.39	...	....	29.70	...
FISH MANURES, SAMPLED BY PURCHASER.														
oe-Mortimer Co. Sent by A. E. Potwine, East Windsor	0.13	‡	6.37	‡	6.50	6.61	0.31	11.54	6.65	18.50	...	36.00	36.80	...
oe-Mortimer Co. Sent by Spencer Bros., Suffield	0.11	0.67	4.56	1.04	6.38	6.61	0.36	12.59	6.83	19.78	18.00	40.00	37.31	7.2
nderson Fertilizer & Chem. Co. Sent by E. B. Sniffen, Stratford	0.50	1.07	5.15	1.80	8.52	8.2	0.60	4.85	1.24	6.69	...	....	41.86	...

ANALYSES OF TANKAGE.

Station No.	Manufacturer.	Dealer or Purchaser.
544	Wilcox Fertilizer Co.	T. H. Eldredge, Norwich
447	Sanderson Fertilizer and Chemical Co.	A. D. Clark, Orange
238	Sanderson Fertilizer and Chemical Co.	C. R. Treat, Orange
218	C. M. Shay Fertilizer Co.	L. M. Benham and S. A. Flight, Higl wood
220	Sanderson Fertilizer and Chemical Co.	Agricultural Station
187	Sanderson Fertilizer and Chemical Co.	Conn. School for Boys, Meriden
789	Unknown	S. D. Woodruff & Sons, Orange
540	Sanderson Fertilizer and Chemical Co.	S. L. Tuttle, Wallingford
528	New England Fertilizer Co.	W. E. Fiske, Warehouse Pt., C. N Burnham, Middlefield
275	L. T. Frisbie Co.	Apothecaries Hall Co., Waterbury
527	American Agricultural Chemical Co.	Pring Bros., Wallingford, E. Hall day, Suffield
278	American Agricultural Chemical Co.	John Gotta, Portland, bought of E Manchester's Sons

As the analyses show, it has a wide range of composition, depending largely on the relative amounts of bone and of meat scraps which were "rendered" as above, but in general, nitrogen gives more than half the value to the material. Like bone the immediate agricultural value of tankage depends not only on the chemical composition but also on the fineness.

All the samples were drawn by the Station agent excepting **789** and **278.** No. **218** is a "fish tankage." The table of analyses shows the state of solubility of the organic nitrogen. As was explained at length in our last report, by determining the nitrogen solubility, it is possible to distinguish between those forms which are readily available to crops and those which are agriculturally inert.

Water-soluble organic nitrogen is that which is soluble in water under the prescribed method of treatment.

Active insoluble organic nitrogen is insoluble in water, but soluble in an alkaline solution of potassium permanganate.

ANALYSES OF TANKAGE.

Dealer's cash price per ton.	Valuation per ton.	Percentage difference between cost and valuation.	Chemical Analysis. Nitrogen. As Ammonia.	Water-Soluble Organic.	Active Insoluble Organic.	Inactive Insoluble Organic.	Total found.	Total guaranteed.	Phosphoric Acid. Found.	Guaranteed.	Mechanical Analysis. Finer than 1-50 inch.	Coarser than 1-50 inch.
34.00	$34.87	2.4*	0.10	0.49	4.72	1.90	7.21	6.6	12.58	10.0	63	37
....	32.55	...	0.16	3.12	3.10	0.74	7.12	7.4	10.75	...	54	46
....	31.91	...	0.15	2.90	2.66	1.21	6.92	7.4	10.48	...	58	42
....	29.21	...	0.32	3.08	2.07	1.24	6.71	...	9.47	...	39	61
....	31.85	...	0.17	2.72	2.48	1.06	6.43	5.0	13.24	12.0	51	49
....	32.44	...	0.12	2.27	2.94	1.03	6.38	5.0	13.41	12.0	61	39
....	27.71	...	0.18	0.48	3.19	2.27	6.12	...	9.43	...	47	53
....	28.49	...	0.15	2.40	2.20	1.15	5.90	5.7	10.27	10.0	45	55
33.00	29.26	12.7	0.14	2.63	1.75	0.78	5.30	5.0	15.66	14.0	41	59
33.00	30.26	9.0	0.20	2.60	1.52	0.87	5.19	4.9	16.20	15.0	58	42
30.00	27.86	7.6	0.32	1.02	2.22	1.19	4.75	4.9	15.66	13.7	49	51
....	27.90	...	0.38	0.98	1.92	1.39	4.67	4.9	15.74	13.7	54	46

* Valuation exceeds cost.

Inactive insoluble organic nitrogen is insoluble in either of the above-named reagents.

All of these forms of nitrogen are found in every organic nitrogenous substance, but the relative quantities are quite different. In general, when more than one-half of the water-insoluble organic nitrogen in any mixture is insoluble in permanganate, the conclusion is justified that some agriculturally inferior form is present.

The same may be suspected if no water-soluble nitrogen is present.

The table shows

1. Judged by the solubility of their organic nitrogen, all of the samples appear to be genuine animal tankage of good quality, though a rather high percentage of the nitrogen in 789, from S. D. Woodruff & Sons, is classed as insoluble inactive.

2. Seven of the twelve samples have 50 per cent. or more finer than 1-50 inch. Other things being equal, fine tankage is preferable to

coarse, and there should be no difficulty in getting more than a half of it in the fine condition.

In the schedule of valuations phosphoric acid in fine tankage is rated at 4 cents per pound and in coarse tankage at 3½ cents; figures which cannot be far wrong because the cost and valuation of the samples received are not far apart and an error will be more likely or will count most in the nitrogen valuation, since the market price of it is four or five times as great as that of phosphoric acid.

3. Figured on the above basis the average cost of phosphoric acid in the tankages is 3 3-4 cents, which makes the nitrogen cost from 17 to 20 cents in the samples highest in nitrogen and from 19.2 to 20 cents in the samples relatively low in nitrogen.

Farmers have bought tankage in car lots or mixed car lots, delivered, for prices which brought the cost of nitrogen down to 12.4 to 17 cents per pound.

The two samples **447** and **238** from the Sanderson Fertilizer Co. have somewhat less nitrogen than guaranteed. The company advises us that the stock from which these goods were bagged showed 7.44 per cent. nitrogen.

The two samples from the American Agricultural Chemical Co. also have somewhat less nitrogen than is guaranteed.

EGG TANKAGE.

This material, No. **31**, is stated to be made from the yolks and shells of eggs, the whites being used in some manufacturing process.

"KANONA."

A nitrogenous material, No. **732**, stated to be of animal origin but to contain no leather and to be highly available.

The analyses of these articles are as follows:

	Egg Tankage.	Kanona.
Nitrogen as ammonia	0.06	0.20
" organic, water-soluble	0.37	1.50
" " active insoluble	1.98	5.81
" " inactive insoluble	1.17	1.49
Nitrogen total	3.58	9.00
Phosphoric acid	1.84	....

BONE MANURES.

In the following table are given the chemical and mechanical analyses of thirty-five samples examined this year.

It will be seen that the term "bone" as used in the fertilizer trade has no very precise meaning. The percentage of nitrogen in these bones ranges from 1.6 to 5.58 and phosphoric acid ranges from 14.74 to 28.53.

Some bone manures consist of dry, clean, pure bones, others of fresh or moist bone with more or less adhering grease and flesh, sometimes mixed with sulphate of soda or other salts to prevent putrefaction, or of bone from which a large part of the nitrogenous matter has been extracted in the manufacture of glue.

In buying bone regard should be had to its fineness as well as to its chemical composition. Fine grinding enormously increases the surface upon which the soil bacteria, the soil water and the crop roots can act to dissolve and make available the substance of the bone.

Two samples, **843** and **865**, contained less nitrogen than was guaranteed, but in each case the percentage of phosphoric acid far exceeded the guaranty.

Five samples, **842, 844, 854, 856, 857**, had less than the guaranteed percentage of phosphoric acid, but in all these cases the excess of nitrogen over the guaranty furnished more than a money equivalent of the deficiency in phosphoric acid.

Lister's Celebrated Ground Bone and Tankage, acidulated, **579**, contains 50 per cent. each of coarse and fine material. It contains:

Nitrogen	2.82
Water-soluble phosphoric acid	5.16
Citrate-soluble phosphoric acid	4.87
Citrate-insoluble phosphoric acid	*3.66*
Total phosphoric acid	13.69

Its cost is $30 and valuation $19.86.

ANALYSES OF

Station No.	Manufacturer and Brand.	Dealer or Purchaser.
	Sampled by Station Agent:	
339	Amer. Agr. Chem. Co., Fine Ground Bone.....	J. A. Glasnap............
340	Amer. Agr. Chem. Co., Fine Ground Bone.....	Chas. Templeton ....
341	Amer. Agr. Chem. Co., Bone Meal............	J. A. Glasnap ....
342	Armour Fertilizer Works, Bone Meal..........	Farmers' Roofing and Supp A. Grulich ....
343	Berkshire Fertilizer Co., Fine Ground Bone...	Hotchkiss & Templeton...
344	Valentine Bohl, Self Recommending Fertilizer.	Apothecaries Hall Co.....
345	Bowker Fertilizer Co., Fresh Ground Bone....	Lightbourn & Pond Co., Bridge's Sons...........
346	Bowker Fertilizer Co., Market Bone...........	J. P. Barstow & Co.......
347	Buffalo Fertilizer Co., Bone Meal	John Reinhardt & Sons ...
348	Coe-Mortimer Co., XXX Ground Bone.........	R. H. Morgan............
349	Peter Cooper Fertilizer Co., Pure Bone Dust..	Apothecaries Hall Co.....
350	Essex Fertilizer Co., Ground Bone............	W. K. Ackley............
351	L. T. Frisbie Co., Fine Bone Meal............	D. W. Ives...............
353	New England Fertilizer Co., Ground Bone.....	T. B. Atwater ....
354	Nitrate Agencies Co., Ground Bone...........	J. R. Houston............
356	Rogers & Hubbard Co., Pure Raw Knuckle Bone Flour...............................	H. W. Andrews..........
357	Rogers & Hubbard Co., Strictly Pure Fine Bone	Warner & Hardin.........
359	Rogers Mfg. Co., Pure Fine Ground Bone	F. S. Platt Co............
358	Rogers Mfg. Co., Pure Knuckle Bone Flour..	Factory..................
355	F.S. Royster Guano Co., Fine Ground Bone Meal	C. E. Kempton...........
360	Sanderson Fert. & Chem. Co., Ground Bone...	F. Hallock Co............
361	C. M. Shay Fertilizer Co., Ground Bone.......	Knowles-Lombard Co.....
362	M. L. Shoemaker & Co., Swift-Sure Bone Meal	Olds & Whipple..........
363	Swift's Lowell Fertilizer Co., Ground Bone....	M. E. Cooke.............
64	The Van Iderstine Co., Pure Ground Bone.....	E. B. Clark Seed Co......
65	Wilcox Fertilizer Co., Pure Ground Bone.....	T. H. Eldredge...........
66	Wilcox Fertilizer Co., Ground Steamed Bone..	Factory ....
	Sampled by Purchasers and others:	
59	Fertilizer Materials Supply Co., Steamed Bone.	A. E. Plant...............
52	E. L. James, Warrenville, Ground Bone	Sent by manufacturer......
21	Pittsburg Provision and Pack. Co., Pure Bone Meal....................................	Station...................
64	Sanderson Fert. and Chem. Co., Fine Ground Bone	E. B. Sniffen.............
65	Sanderson Fert. and Chem. Co., Fine Ground Bone......................................	E. B. Sniffen ....
31	Sanderson Fert. and Chem. Co., Fine Ground Bone......................................	O. G. Beard..............
39	Manufacturer unknown, Ground Bone.........	Amer. Sumatra Tobacco Co

Bone Manures.

	Valuation per ton.	Percentage difference between cost and valuation.	Chemical Analysis.				Mechanical Analysis	
			Nitrogen.		Phosphoric Acid.		Finer than 1-50 inch.	Coarser than 1-50 inch.
			Found.	Guaranteed.	Found.	Guaranteed.		
00	$28.37	23.4	2.52	2.5	26.40	22.0	50	50
00	28.19	24.2	2.60	2.5	24.72	22.0	68	32
00	18.18	65.0	1.60	1.7	16.84	13.7	53	47
00	26.35	25.2	2.66	2.5	22.16	22.5	66	34
00	29.83	7.3	2.14	2.5	27.45	20.0	94	6
00	32.32	2.1	4.28	3.8	22.03	23.0	72	28
00	27.13	25.3	2.75	2.5	23.26	22.8	57	43
00	18.98	58.1	2.35	1.9	14.74	13.7	48	52
00	29.74	0.8	3.58	2.9	23.33	22.0	51	49
00	28.20	6.4	2.42	2.5	25.33	23.0	72	28
00	28.48	5.3	2.43	2.1	27.48	22.0	41	59
00	30.38	15.2	2.70	2.5	27.12	23.0	67	33
00	31.39	1.9	4.01	3.3	23.56	18.0	51	49
00	31.64	7.5	2.88	2.5	27.91	23.0	68	32
00*	26.59	5.3	2.66	2.5	22.49	22.9	65	35
00	32.57	16.7	3.96	3.8	24.03	24.7	69	31
0	27.23	26.7	3.60	2.9	20.37	22.0	44	56
00	35.18	14.5	3.52	3.0	25.97	22.0	82	18
00	34.45	4.5	3.90	3.8	25.59	24.0	81	19
00	26.38	25.1	2.41	2.5	23.90	22.9	56	44
00	29.63	11.4	2.70	2.5	27.27	20.0	50	50
00	28.02	17.8	3.00	1.6	23.92	22.9	47	53
00	36.28	4.7	5.58	4.5	22.36	20.0	58	42
00	29.54	4.9	2.70	2.5	26.25	23.0	64	36
00	28.06	6.9	2.28	2.0	27.58	27.0	42	58
00	29.08	10.0	2.32	2.5	28.53	22.0	45	55
0	27.49	7.3	2.05	1.6	27.50	24.0	47	53
00	.....	....	2.59	2.1	20.64	22.9	73	27
00	.....	....	4.01	...	20.85	....	5	95
00	.....	....	3.94	...	20.38	....	62	38
.	.....	....	3.01	2.5	24.78	20.0	48	52
.	.....	....	2.55	2.5	26.42	20.0	50	50
0	.....	....	2.30	2.5	23.44	20.0	41	59
0	.....	....	0.74	...	33.10	....	93	7

* Car lot, delivered.

THE COST OF PLANT FOOD IN RAW MATERIALS.

The facts regarding market prices which have been shown in detail in the preceding pages may here be brought together for comparison.

NITROGEN.

The following table gives the percentage of nitrogen, the average retail price and the actual cost of nitrogen both at retail and in mixed car lots of the various nitrogenous raw materials in our market.

	Percentage of Nitrogen.	Cost per ton.	Nitrogen costs cents per pound retail.	Cash cost in mixed car lots.
Nitrate of Soda....	15.5	$50.00	15.9 to 16.7, av. 16.3	14.9 to 15.7
Dried Blood......	13.0	.....	....	20.6
Cotton Seed Meal.	6.0 to 7.6	31.50	17.4 to 25.5, av. 20.2‡	20.2
Castor Pomace....	4.5 to 5.2	25.00	22.3 to 25.9, av. 24.6	....
Linseed Meal.....	5.3	.....	....	....
Dry Ground Fish..	8.5*	43.50	20.3 to 24.2, av. 22.5	....
Tankage	4.7 to 7.2†	30 to 34	17 to 20	12.4 to 17.0

* And 7.1 per cent. of phosphoric acid. † And 9.4–16.2 per cent. of phosphoric acid. ‡ In car lots.

The table shows that in general nitrogen in castor pomace has cost more than in other forms, 24.6 cents per pound, and that of dry ground fish comes next, 22.5. The nitrogen of tankage and cotton seed meal has been bought at about the same price and that of nitrate of soda has been much cheaper than in any other of these forms, costing a fifth less. Being cheaper and more quickly available than other forms, it should be used wherever it can be with advantage. For top dressing winter grains and meadows, as a "starter" for potatoes and other early planted crops, and in orchards it deserves more general use.

PHOSPHORIC ACID.

	Percentage of Phosphoric Acid.	Citrate-Soluble.	Cost per ton.	Citrate-Soluble costs cents per pound, retail.	Cash cost mixed car
nd Phosphate					
ck	25.4	....	$10.30*	2.0†	1¼†
Slag..........	17.0	15.7	15 to 18	5.1	4.1 to 4
pitated Bone...	38.0	35.8 to 38.6	....	5.0	....
Phosphate	15 to 17	13.8 to 15.9	14.50 to 17.75	4.9 to 6.4, av. 5.3	3.6 to

ar lots. bags. † Cost of *total* phosphoric acid.

This table includes the chief commercial sources of phosphoric acid, excepting bone. Insoluble and comparatively inert phosphoric acid costs in car lots less than two cents a pound. Citrate-soluble phosphoric acid either in basic slag, precipitated bone, or acid phosphate, costs about 5 cents at retail but in mixed car lots can be bought for cash for a cent less. In selecting it must be remembered that "precipitated bone" is neutral in reaction and is specially used as a tobacco fertilizer; basic slag is strongly alkaline, containing from 40-50 per cent. of lime, a part of which is probably uncombined with phosphoric acid, while acid phosphate is strongly acid in reaction, and may contain some free sulphuric acid and also a large amount of sulphate of lime, land plaster. It has been pointed out by others that sulphate of lime, like many other salts, may act on some soils as a potash fertilizer, its lime displacing potash from certain hydrous silicates, zeolites, and making it more quickly available to crops.

POTASH.

	Percentage of Potash.	Cost per ton.	*Potash* costs cents per pound retail.	*Cash cost* in mixed car lots.
High-grade Sulphate........	49 to 51	$48 to 51	5	5.0
Low-grade Sulphate........	25.5 to 27.7	31	6.1	4.9
Muriate....................	49 to 52.1	40 to 48	3.9 to 4.6	3.6 to 3.9
Kainit......................	11.2 to 14.0	....	....	3.9
Vegetable Potash (carbonate)	26.4	43.00	8.1	....
Cotton Hull Ashes.........	22 to 26.6	36 to 55	8.2 to 11.2	....

The above figures show that potash in form of carbonate costs fully three cents more per pound than in any other form. It has been a favorite form of potash for tobacco and some lands have unquestionably been overdosed with it.

Our own experiments at Poquonock indicated a somewhat unfavorable effect on the burn of the tobacco leaf when sulphate of potash was used, but many growers have used it without causing any such defect. In our tests unnecessarily large quantities of sulphate were used. On old tobacco land, 300 pounds of high-grade sulphate of potash should certainly be enough. Some fruit growers prefer either the high grade or double sulphate of potash for orchard fertilizers, believing that where it is used the color of the fruit is better than where the cheaper muriate is substituted. Whether this is generally true is quite uncertain.

Our observation and experience make very clear the extreme importance of coöperative buying for cash where this can possibly be done. A much larger part of the fertilizers used in Connecticut could be bought in car lots than is now done with a saving of 10 per cent. or more in their cost.

V. MIXED FERTILIZERS.

MIXTURES OF PHOSPHATES WITH POTASH SALTS.

733. Grass and Oats Fertilizer, made by American Agricultural Chemical Co., New York City; sampled from stock of C. A. Cowles, Plantsville.

734. Wheeler's Grass and Oats, made by American Agricultural Chemical Co., New York City; sampled from stock of L. L. Loomis, East Granby.

348. A mixture claimed by the manufacturer to be two-thirds by weight of acid phosphate and one-third high-grade sulphate of potash, 52 per cent. Sent by R. S. Rounds, Cannon Station.

	733	734	348
Water-soluble phosphoric acid	9.47	9.22	.....
Citrate-soluble phosphoric acid	2.52	1.72	.....
Citrate-insoluble phosphoric acid	0.61	0.20	.....
Total phosphoric acid found	12.60	11.14	.....
" " " guaranteed	12.00	12.00	.....
Water-soluble potash found	2.25	2.17	13.64
Potash guaranteed	2.00	2.00	.....
Cost per ton	$25.00	$23.00	.....
Valuation per ton	$12.69	$11.60	.....
Percentage difference between cost and valuation	97.00	98.3	.....

1575 pounds of acid phosphate and 90 pounds of muriate of potash contain as much plant food as either of the above grass mixtures and can be readily bought anywhere in the state for about $14.50 and usually for considerably less.

The percentage of potash in **348** indicates that only about one-fourth of the mixture was 52 per cent. high-grade sulphate of potash.

NITROGENOUS SUPERPHOSPHATES.

(ANALYSES ON PAGES 58 TO 83.)

In the following table are 273 analyses of samples of nitrogenous superphosphates which were drawn by the Station agent, and eight analyses of samples sent by individuals. The brands are given under the names of their manufacturers, arranged alphabetically.

All of the determinations are made in duplicate by expert chemists, are frequently checked by chemists elsewhere, and we have every reason to believe, are correct. We may assume a possible error not greater than 0.1 per cent. of nitrogen and 0.15 per cent. of phosphoric acid and potash, due to errors of analysis.

Whether the samples accurately represent the average composition of the brands is less certain. At least three packages of each brand are sampled with an instrument which takes a section of the contents from top to bottom. Often a considerably larger number are thus sampled, and the analysis is made on a mixture of these separate samples. Frequently samples of a given brand are drawn as above described in several different towns, and these samples are mixed and analyzed as one sample.

Nevertheless, as will appear on following pages, the analysis in some cases is unsatisfactory to the manufacturer, who claims that it does not represent fairly the average quality of the brand in question. Analyses of the same brand made on samples drawn in other states or on samples drawn from the factory pile from which the shipment was made, show results quite different from our own.

The causes of these discrepancies, irritating alike to the manufacturer and to the Station, are various. Some are quite evident and others are probably not understood. A mixture of dry materials which have very different specific weights always separates more or less when it is moved or shaken either in the pile or in the bags. In a pile of such a mixture the coarser and heavier particles will be found around the outside edge of the heap, and goods bagged from this part will not have the same composition as from other parts of the pile.

When fertilizer bags are torn in handling, the dealer must rebag their contents, and he uses what sacks he may have at

hand. If they are stenciled with the name of a different brand, confusion is likely to result. In some cases it has been quite clear that this has happened, and any shortage of weight had been made good by fertilizer sweepings. If one such bag is among those which are sampled, of course the analysis will be misleading.

The differences between the analyses made by the manufacturers and those made in the course of fertilizer inspection are almost invariably due to differences in sample and not to errors of analysis. Differences in sample may be attributed to three or four causes, loss or gain of moisture, lack of uniformity in the different packages, mistakes in brands or tags, and faulty method of sampling. The last of these alone is the responsibility of the Station. Every effort is made by it to follow a method which will give a perfectly representative sample of the packages opened and of the whole stock, provided that they are reasonably uniform in composition. Each analysis is reported as soon as done to the persons owning the stock, and also to the manufacturer. If the analysis does not in his view represent the goods fairly, the Station has, wherever it could be done, drawn and tested other samples of the brand. It cannot, however, suppress any analysis which it has made.

The water-solubility of the organic nitrogen has been determined in all cases, and where this was suspiciously low, both the active- and inactive-insoluble nitrogen have been determined. Experience indicates that when there is a fair proportion of water-soluble organic nitrogen, no undue proportion of inactive-insoluble nitrogen will be present.

When more than one-half of the organic nitrogen is classed as inactive-insoluble, it indicates that inferior forms of nitrogen have been used, in part at least, and if after deducting the inactive-insoluble nitrogen from the percentage of total nitrogen found, the remainder is not as much as the guaranty, it cannot be fairly claimed that the goods are as guaranteed.

The brands are discussed in what follows in the order in which they are tabulated.

American Agricultural Chemical Co.

510. Complete Tobacco Manure shows an overrun of 0.40 per cent. nitrogen and 1.84 available phosphoric acid, and a

deficiency of 0.80 per cent. potash. The manufacturer asked that another sample be drawn, which was done.

Its analysis, **720**, shows about the same nitrogen as **510**, available phosphoric acid 5.20 instead of 4.84, but potash 5.81 instead of 4.70.

721. Complete Tobacco Manure from Carbonate having shown a deficiency of 0.33 per cent. of potash, a second sample, **867**, was analyzed in which the potash was well above the guaranty.

819. H. G. Tobacco Manure. The nitrogen is 0.80 and the potash 0.85 per cent. below guaranty. There is an overrun of 1.32 per cent. in available phosphoric acid.

A sample drawn in another place, **895**, showed a deficiency of only 0.18 per cent. of nitrogen, while available phosphoric acid was 1.7 and potash 0.15 above guaranty.

695. Packer's Union Gardener's Complete Manure showed an overrun of 0.17 per cent. nitrogen and 0.36 available phosphoric acid, and a deficiency of 0.71 potash. Another sample subsequently drawn, **825**, showed an overrun of 0.18 nitrogen and 1.69 available phosphoric acid, and a deficiency of 1.82 per cent. of potash.

Of the forty-four brands of the American Agricultural Chemical Company's fertilizers which we examined (forty-eight analyses), the nitrogen in three cases, potash in eleven cases, and both nitrogen and potash in one case, are below the guaranty. In all but one case the deficiency in one ingredient is fully made up in money-value by an overrun of the others. The single case is **819**, H. G. Tobacco Manure, which shows a money deficiency of $2.70. The second sample, above referred to, however, shows no such deficiency.

The solubility of the nitrogen in all the samples examined is satisfactory.

Armour Fertilizer Works.

369. Bidwell's Formula for all Crops. The nitrogen was 0.45 per cent. and potash 0.41 per cent. below guaranty and available phosphoric acid 0.29 per cent. above guaranty. On request, a second sample was drawn and analyzed, **516**, in which the nitrogen was 0.18 per cent. and potash 0.39 per cent. below, and available phosphoric acid 0.16 above guaranty.

Of the twelve samples (eleven brands) analyzed, two are below guaranty in both nitrogen and potash, one each in nitrogen, potash and available phosphoric acid. In two cases the deficiency of one or more ingredients is not made good in money-value by an overrun in the other, the deficit being $1.82 per ton in **369** and $0.88 in **516**, both being Bidwell's Formula for all Crops.

If the inactive-insoluble nitrogen in Brewer's Special Tobacco Fertilizer is deducted from the total nitrogen, the remainder, active nitrogen, falls 1.57 per cent. below the guaranty.

Berkshire Fertilizer Co. All of the six brands meet their guaranties and the nitrogen solubility is satisfactory.

F. E. Boardman. **309.** Complete Fertilizer. The available phosphoric acid is 0.38 per cent. below guaranty, but the deficiency is more than made good by the overrun of nitrogen.

Bowker Fertilizer Co. Bowker's Complete Alkaline Tobacco Grower (with potash as carbonate), **730**, had 0.91 per cent. less potash than guaranteed and .08 per cent. nitrogen and 2.09 per cent. available phosphoric acid more than guaranteed. A second sample, **868**, was drawn by thoroughly mixing the contents of four bags on the floor and sampling this mixture. It contained 0.14 more nitrogen, 1.03 more of available phosphoric acid and 1.22 per cent. more potash than was guaranteed.

Stockbridge Potato and Vegetable Manure, **285**, contained 1.04 per cent. more available phosphoric acid than guaranteed, but 0.7 per cent. less of potash. Upon request a second sample, **432**, was drawn and examined. This sample contained 0.70 more available phosphoric acid and 0.61 per cent. less potash than the guaranty, the two samples having approximately the same composition. Each of the three samples, of which **285** is a mixture, was separately tested for potash and contained 8.97, 9.27 and 9.76 per cent. respectively.

The manufacturer advises that a sample drawn from stock of W. B. Rice, Meriden, by their agent, who mixed the contents of four bags and sampled this mixture, contained 10 per cent. of potash.

Stockbridge Special Complete Manure for Tobacco, **742**, contained 2.34 per cent. less of nitrogen and 0.82 per cent. more of

available phosphoric acid and 2.45 per cent. more of potash than was guaranteed. Such wide differences strongly suggest a confusion of brands and that the material sampled was not representative of the brand named.

A second sample, **896**, was therefore drawn and analyzed, which showed 0.48 per cent. of nitrogen and 0.17 per cent. of potash less than guaranteed and 1.79 per cent. overrun of available phosphoric acid.

Of the twenty-three analyses of the Bowker Fertilizer Co.'s goods (twenty brands), eleven are below guaranty; two in nitrogen, one in phosphoric acid, one in both nitrogen and potash and seven in potash. In every case, however, the deficiency in one ingredient is fully made good, in respect of money value, by an excess over guaranty in the other ingredients.

Buffalo Fertilizer Co. The sample of Celery and Potato Special, **290**, showed nitrogen 0.25 per cent. and available phosphoric acid 0.48 per cent. in excess of guaranty but potash 1.29 per cent. below guaranty. The solubility of the nitrogen was also low. At the request of the manufacturer—who stated that repeated analyses of the pile from which this brand was shipped had shown in every case more than 10 per cent. of potash—another sample was drawn by the Station agent, **467**, which gave 0.62 per cent. of available phosphoric acid and 0.21 per cent. of potash in excess of guaranty.

Potash was also separately determined in the three individual samples which were mixed to make up **290**, and there was found respectively 7.16, 9.22, and 10.24 per cent. The lowest percentage was in the sample drawn of John Reinhardt & Sons, W. Cheshire.

Three of the nine brands sold by this company did not have the full amounts of plant food guaranteed, two being deficient in potash and one in nitrogen, but in all but one, **698**, a deficiency of one ingredient is made good, as far as money equivalent is concerned, by excess of other ingredients. In this one case the money equivalent of the deficiency is about $1.70 per ton.

If the inactive, insoluble nitrogen in Buffalo Tobacco Producer is deducted from the total nitrogen, the remainder is 1.15 per cent. short of the amount guaranteed; that is, the guaranteed amount of nitrogen is not fully supplied in active forms.

Chittenden Fertilizer Co.'s Tobacco Grower. **624.** The sample was drawn from two agents in Broad Brook and one in Windsorville. The nitrogen found was less than the amount guaranteed by 0.20 per cent., while the available phosphoric acid exceeded the guaranty by 0.44 per cent. and potash by 2.81 per cent. The manufacturer stated that the goods shipped to one of the agents were all from one car, every tenth bag had been sampled and analysis of the mixed sample by a Baltimore commercial chemist gave, nitrogen 4.96, available phosphoric acid 4.32, potash 8.85 per cent. The manufacturer further stated that both of the other Connecticut agents had only goods from another single car which was sampled as above described and a mixture of samples from this car and several others loaded from the same stock showed nitrogen 5.01, available phosphoric acid 4.65, potash 8.65 per cent., figures which differ slightly from analysis **624** in nitrogen and phosphoric acid but very widely differ as to potash.

In view of these facts, the manufacturer requested careful review of all the work, asserting that the Station analysis did not represent the quality of the goods.

In each of the three samples of which **624** is made up, nitrogen was determined, and the following percentages found, 4.66, 4.81, 4.93; average, 4.80, the same figure reported in **624.** The figures indicate no very great difference in the composition of the samples. Our sampling agent endeavored, but was not able, after the request was made, to find this brand in hands of agents and so we were unable to make further analyses. The chemists above referred to, Wiley & Co., kindly forwarded portions of their samples, which were examined at this Station. The results were substantially the same as those obtained by the manufacturer's chemist, the Station figures for potash being slightly higher.

Two of the eight brands of the E. D. Chittenden Co. do not fully meet their guaranty in all particulars, one being deficient in nitrogen and one in potash, but in each case the excess over guaranty of other ingredients much more than makes good the money value of the deficiency in one.

The E. B. Clark Co.'s brands meet their guaranties in all respects.

The Coe-Mortimer Co.'s Complete Manure with ten per cent. of potash, sample **471**, contained 1.86 per cent. more of available phosphoric acid than was guaranteed and 0.21 per cent. less of potash. The three samples from which **471** was prepared contained respectively 9.65, 9.91 and 9.81 per cent. of potash.

Coe-Mortimer's Peruvian Tobacco Fertilizer, **618**, showed a deficiency of 0.44 per cent. of nitrogen and 0.38 per cent. of potash and an overrun of 1.28 per cent. of available phosphoric acid.

Coe-Mortimer's Vegetable Grower, sample **752**, showed a deficiency of 0.57 per cent. of potash and an overrun of available phosphoric acid of the same amount.

In these three cases a part of our sample was sent to the company to check our work and an unsuccessful effort made to draw other samples from the market for analysis.

Of the nine brands sold by this company three show deficiency of potash and one of both nitrogen and potash. In **618** and **752** the money equivalent of these deficiencies is not fully compensated by an overrun of other ingredients.

The Connecticut Valley Orchard Co.'s Special Fertilizer and the two brands of *T. H. Eldredge's* goods contain the guaranteed amounts of plant food.

Three brands of the *Essex Fertilizer Co.'s* goods show small deficiencies of nitrogen, this being more than made good in money equivalent by an overrun of the other ingredients.

The Fertilizer Materials Supply Co.'s No. 1 Potato and General Truck, sample **452**, shows a deficiency of 0.56 per cent. of potash, a very slight deficiency of nitrogen and an excess over guaranty of 0.48 per cent. of available phosphoric acid, which does not quite make good in money equivalent the other deficiencies.

The L. T. Frisbie Co.'s Connecticut Special Fertilizer, sample **312**, having shown a deficiency of 0.29 per cent. potash, a second sample, **468**, was tested, and showed a deficiency of 0.16 per cent. of nitrogen, 0.12 available phosphoric acid and 0.97 per cent. of potash.

Frisbie's Corn and Grain Fertilizer, sample **294**, showed a deficiency of 0.24 per cent. potash, with an excess of 0.38 per

cent. nitrogen and 1.52 per cent. available phosphoric acid. The manufacturer stated that analyses of this brand in bulk had shown 3.07 per cent. of potash. Potash determined separately in the three samples of which **294** was made up showed 2.72, 2.89 and 2.70 respectively. A second sample, **451**, was also taken, from stock of Lightbourn & Pond, the analysis of which met the guaranty in all respects.

Of the five brands of this company, two were deficient in potash and one in nitrogen and potash. In one case, **468**, the money equivalent of the guaranty was deficient by $1.51.

Lister's Agricultural Chemical Works. All of the ten brands fully meet their guaranties, with exception of a deficiency in available phosphoric acid of 0.58 per cent. in **771**, which is more than compensated by an overrun in the other ingredients.

E. Manchester & Sons' Manchester's Formula, sample **625**, shows a deficiency of 0.70 per cent. of potash and an overrun of available phosphoric acid of 0.92 per cent. A second sample, **805**, shows a deficiency of nitrogen of 0.30 and of potash of 0.42 per cent., with an overrun of available phosphoric acid of 0.61 per cent. At the urgent request of the manufacturer, a third sample was drawn and analyzed, **913**, which showed a deficiency of 0.32 per cent. of nitrogen with an overrun of 0.62 of available phosphoric acid and 0.13 of potash.

Manchester's Special, sample **765**, shows a deficiency of 0.36 per cent. nitrogen, 1.72 per cent. of potash and an overrun of 0.4 per cent. available phosphoric acid.

Of the five analyses, three brands, one is deficient in potash, one in nitrogen and two are deficient in both nitrogen and potash. Two analyses, **805** and **765**, show a deficiency of money value in plant food of $1.00 and $2.49 respectively.

Mapes Formula and Peruvian Guano Co.'s fifteen brands all fully meet their guaranties, with the exception of **553**, in which a deficiency of 0.37 per cent. of potash is fully offset by an overrun of 0.7 per cent. nitrogen.

The National Fertilizer Co.'s Eureka Potato Fertilizer, sample **585**, taken from three different places and from nineteen pack-

, showed a deficiency of 0.92 per cent. of potash with an
run of 0.11 per cent. nitrogen and 0.51 per cent. available
phoric acid. The manufacturer tested a portion of our
ıle, corroborating our result on potash and asked that a
ıd sample be drawn. This second sample, **793**, drawn from
ı bags, showed a deficiency of 1.85 per cent. potash and an
run of 0.32 per cent. nitrogen and 1.15 per cent. available
phoric acid.

: the fourteen analyses (twelve brands) of this company
are deficient in nitrogen and four in potash. In one case,
the deficiency is not made good in money value by the
ss of other ingredients, this difference amounting to about
y-seven cents.

: *The New England Fertilizer Co.'s* seven brands, two are
ient in potash and one in nitrogen, and in each case the
iency is made good by an excess of the other ingredients.

the *Niantic Menhaden Fish Oil & Guano Co.'s* five brands
.s deficient in nitrogen but this is more than made good by
xcess of the other ingredients.

ds & Whipple's seven brands fully meet their guaranties
the exception of **277**, where a small deficiency in available
phoric acid is compensated by a large overrun of potash.

the five brands of *Parmenter & Polsey,* three are somewhat
ent in potash and one is deficient in nitrogen, with a slight
un of some other ingredient.

e F. S. Platt Co.'s Market Garden Phosphate fully meets
ıaranty.

e Rogers & Hubbard Co.'s Bone Base Soluble Tobacco
ıre, sample **588**, shows 1.05 per cent. of chlorine. The
ıfacturers asked for a re-test, as only high-grade sulphate
ɔtash was used in this brand. The percentage of chlorine
found to be the same in each of the samples of which **588**
nade up. Even the high-grade sulphate of potash contains
ce or more of chlorine and it is likely to be found in small
ınt in nitrogenous materials. One per cent. of chlorine in

a tobacco fertilizer is absolutely without effect on the quality of the crop. It amounts to twenty pounds per acre, if a ton of the fertilizer is used. An ordinary dressing of stable manure, which is used everywhere and everywhere acknowledged as one of the best tobacco fertilizers, contains a good deal more chlorine than this. Most growers are too particular about chlorine. More attention to lack of lime and less to presence of chlorine in their fertilizers would be worth while. In this fertilizer there is a slight deficiency of potash fully compensated in money value by an overrun in the other ingredients. The other seven brands fully meet their guaranties in all particulars.

The eleven brands of the *Rogers Manufacturing Co.* fully meet their guaranties, excepting **735**, in which a deficiency of potash of 0.50 per cent. is fully compensated in money value by an excess of phosphoric acid.

Royster's High-Grade Tobacco Manure, sample **628**, shows a deficiency of 1.3 per cent. potash and 0.56 per cent. nitrogen and an overrun of 2.65 per cent. available phosphoric acid. The manufacturer protested that the goods were made with safe overruns of each ingredient and that the above sample was certainly not representative and requested the analysis of another sample. Our agent tried unsuccessfully to find other stock of this brand in the State. Tests of nitrogen in the three samples, of which **628** is a mixture, gave 3.95, 4.16 and 4.72 per cent., a wide difference, but in no case meeting the guaranty.

The analysis of Royster's Tobacco Ash Components, sample **660**, was protested by the manufacturer because, while only high-grade sulphate was used in its manufacture, the analysis showed over 10 per cent. of chlorine.

With the above exceptions the nine brands of this company's manufacture fully met their guaranties.

The nine brands of the *Sanderson Fertilizer and Chemical Co.* fully meet their guaranties in all respects.

One of the brands of the *C. M. Shay Fertilizer Co.*, **569**, shows a deficiency of 0.23 per cent. potash but an overrun of 0.48 per cent. of nitrogen, which more than compensates in money equivalent. Another, **645**, is deficient in available phosphoric acid with an overrun of the other ingredients.

The nitrogen in one of *M. L. Shoemaker & Co.'s* brands, **808**, is 0.23 below guaranty, compensated in money equivalent by an overrun in available phosphoric acid.

Of the thirteen brands of the *Swift-Lowell Fertilizer Co.*, four are deficient in nitrogen and two in potash, but the excess of other ingredients over guaranty makes good the money equivalent of the deficient elements.

One of the two brands of *Tanner & Wilcox* is deficient in available phosphoric acid, but this is compensated by an excess of 0.61 per cent. of nitrogen.

All of the ten brands of the *Wilcox Fertilizer Co.* fully meet their guaranties.

S. D. Woodruff & Sons' Home Mixture, **346**, exceeds the guaranteed potash by 0.27 per cent. and the guaranteed nitrogen by 0.43 per cent. This nitrogen, however, has a lower solubility than that of any other sample examined. If the insoluble-inactive nitrogen is deducted, the amount of active organic nitrogen is less than the guaranty by 0.59 per cent.

Summary regarding Guaranties.

Of the 273 analyses representing 258 brands, eighty-one show deficiencies in respect of one or more ingredients; thus twenty-two are deficient in nitrogen, five in "available" phosphoric acid, forty-three in potash and eleven others in both potash and nitrogen or potash and phosphoric acid.

In twelve cases these deficiencies are not fully compensated by an overrun of the other ingredients, so that the goods neither contain what they are guaranteed to contain, nor its fair equivalent.

COST.

The cash retail price is quoted by each agent from whom a sample is drawn and these prices are reported to manufacturers for criticism. If quotations on a given brand are widely divergent the dealers are asked to confirm or correct the figures. The average of the several quotations is given in the table.

Nitrogenous Superphosphates.

Station No.	Manufacturer and Brand.	Place of Sampling.	Dealers' average cash price per ton.	Valuation of the Plant Food in one ton, see p. 3.
	Sampled by Station Agent:			
	The American Agricultural Chemical Co., New York City.			
6	Complete Manure with 10% Potash..	Meriden, Milford, Burnside	$38.00	$25.8
0*	Complete Tobacco Manure (from Sulphate)........	East Windsor Hill, Burnside........	36.00	28.0
0	Complete Tobacco Manure (from Sulphate)........	Broad Brook, So. Manchester........	36.00	29.2
1†	Complete Tobacco Manure (from Carbonate)........	So. Manchester........	37.00	29.9
7	Complete Tobacco Manure (from Carbonate)........	Hillstown........	37.00	29.6
6	Grass and Lawn Top Dressing......	New Haven, Meriden, Milford........	33.50	20.5
0	H. G. Fertilizer, 10% Potash........	Rockville, Putnam........	38.00	22.9
9†	H. G. Tobacco Manure........	Broad Brook........	48.00	32.2
5	H. G. Tobacco Manure........	Windsor........	48.00	36.2
3	Tobacco Starter and Grower........	Broad Brook, New Milford	38.00	24.3
	Bradley Branch:			
1	Complete Manure for Potatoes and Vegetables........	Norwich Town, Milford...	36.50	26.6
2	Complete Manure for Top Dressing, Grass and Grain........	Hazardville, East Windsor Hill........	38.75	27.3
8	Corn Phosphate........	Rockville, Norwich Town, Milford........	29.50	16.9
3	Eclipse Phosphate........	Milford, Putnam........	27.50	14.1
8	Farmers' New Method Fertilizer....	Middletown, Putnam, Stafford Springs........	30.00	17.3
0	Niagara Phosphate........	Milford, Putnam........	26.50	12.5
1	Potato Fertilizer........	Middletown, Putnam......	30.50	17.6
9	Potato Manure........	Rockville, Norwich Town, Milford........	32.00	19.2
7	XL Superphosphate........	Suffield, Norwich Town, Burnside........	33.25	20.0
	Church Branch:			
8	Fish and Potash........	Wallingford, Hazardville, Meriden........	26.75	17.0

* See note, p. 48. † See note, p. 49.

ANALYSES AND VALUATIONS.

Nitrogen.					Phosphoric Acid.							Potash.	
			Total Nitrogen.					Total.		So-called "Available."			
In Ammonia.	Organic, water-soluble.	Organic, water-insoluble.	Found.	Guaranteed.	Water-soluble.	Citrate-soluble.	Citrate-insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.
1.65	0.28	1.23	3.20	3.3	5.44	1.34	0.68	7.46	7.0	6.78	6.0	9.80	10.0
0.16	0.51	3.99	4.95	4.5	1.08	3.76	1.62	6.46	4.0	4.84	3.0	[1]4.70	5.5
0.95	0.82	3.21	4.98	4.5	1.15	4.05	1.62	6.82	4.0	5.20	3.0	[2]5.81	5.5
0.05	1.06	3.36	4.67	4.5	0.18	5.78	2.29	8.25	4.0	5.96	3.0	[3]5.17	5.5
0.03	4.25		4.65	4.5	0.59	3.38	1.48	5.45	4.0	3.97	3.0	[4]5.92	5.5
0.15	0.26	1.18	3.84	3.9	2.92	2.75	1.19	6.86	6.0	5.67	5.0	2.15	2.0
0.86	0.22	0.76	2.43	2.5	4.25	2.46	1.29	8.00	7.0	6.71	6.0	9.59	10.0
3.04	0.28	1.51	5.00	5.8	4.46	1.86	0.74	7.06	6.0	6.32	5.0	[5]9.15	10.0
3.10	2.39		5.62	5.8	4.82	1.88	0.52	7.22	6.0	6.70	5.0	[6]10.15	10.0
2.14	0.30	0.93	3.37	3.3	7.63	1.23	0.57	9.43	9.0	8.86	8.0	[7]4.45	4.0
0.63	0.52	1.23	3.31	3.3	5.13	4.13	2.24	11.50	9.0	9.26	8.0	7.13	7.0
1.01	0.22	2.38	4.85	4.9	3.24	2.24	1.04	6.52	5.0	5.48	4.0	5.83	6.0
0.51	0.26	0.85	2.12	2.1	5.17	3.31	1.50	9.98	9.0	8.48	8.0	1.81	1.5
0.23	0.32	0.56	1.23	1.0	5.42	2.62	1.06	9.10	9.0	8.04	8.0	2.63	2.0
0.58	0.27	0.77	1.93	1.7	5.53	2.69	1.43	9.65	9.0	8.22	8.0	3.26	3.0
0.34	0.18	0.55	1.20	0.8	5.12	2.45	0.91	8.48	8.0	7.57	7.0	1.50	1.0
1.05	0.16	0.72	2.04	2.1	5.75	2.74	1.05	9.54	9.0	8.49	8.0	3.11	3.0
0.98	0.26	0.76	2.42	2.5	4.48	2.45	1.78	8.71	7.0	6.93	6.0	4.78	5.0
0.44	0.30	1.10	2.42	2.5	7.01	3.04	1.51	11.56	10.0	10.05	9.0	2.37	2.0
0.35	0.34	1.44	2.23	2.1	3.69	3.12	2.03	8.84	7.0	6.81	6.0	2.58	2.0

[1] 0.70% potash as muriate, 4.00% as sulphate.
[2] 1.00% potash as muriate, 4.81% as sulphate.
[3] 1.00% potash as muriate, 1.73% as sulphate, 2.44% as carbonate.
[4] 0.60% potash as muriate, 1.19% as sulphate, 4.13% as carbonate.
[5] 2.50% potash as muriate, 6.65% a sulphate.
[6] 1.20% potash as muriate, 8.95% a sulphate.
[7] 0.82% potash as muriate, 3.63% a sulphate.

NITROGENOUS SUPERPHOSPHATES.

Manufacturer and Brand.	Place of Sampling.	Dealers' average cash price per ton.	Valuation of the Plant Food in one ton, see p. 3.
Sampled by Station Agent:			
Great Eastern Branch:			
General	Madison, New Canaan	$28.00	$14.76
H. G. Vegetable, Vine and Tobacco Fertilizer	Colebrook, East Hampton, Madison	33.75	20.76
Northern Corn Special	East Hampton, No. Granby	32.00	19.53
Northwestern Branch:			
Fish, Bone and Potash	New Haven, Suffield, Hazardville	30.00	19.36
Market Garden Phosphate	Southport, Stamford	33.50	22.08
10% Potato Fertilizer	Wallingford, Hazardville	33.50	23.40
Universal Fertilizer	New Canaan	38.00	20.43
Packers' Union Branch:			
Animal Corn Fertilizer	Waterford, Middlebury	33.50	19.07
*Gardeners' Complete Manure	New Canaan, Middlebury	37.00	25.02
Gardeners' Complete Manure	Watertown	37.00	25.23
Potato Manure	Waterford, Ellington, East Hampton	32.25	20.47
Quinnipiac Branch:			
Climax Phosphate	Milford, Plainfield, Danielson	29.25	13.96
Corn Manure	Wallingford, Westport	31.00	17.40
Market Garden Manure	Milford, Southport	37.00	25.77
Phosphate	Putnam, New London	32.50	19.77
Potato Manure	Wallingford, New London, Westport	32.75	19.79
Potato Phosphate	Wallingford, New London, Westport	32.00	18.58
Read Branch:			
Practical Potato Special	Westport, East Hampton, Plantsville	32.00	16.00
Standard Superphosphate	Bristol, So. Meriden, E. Canaan	29.25	14.93
Vegetable and Vine Fertilizer	Bristol, So. Meriden	33.00	20.46
Wheeler Branch:			
Corn Fertilizer	E. Granby, Riverton, No. Granby	29.75	16.51
Havana Tobacco Grower	E. Granby, Riverton, No. Granby	36.25	25.63
Potato Manure	E. Granby, Riverton, No. Granby	30.75	18.28

* See note, p. 49.

Analyses and Valuations—*Continued.*

Nitrogen.					Phosphoric Acid.							Potash.	
			Total Nitrogen.					Total.		So-called "Available."			
In Ammonia.	Organic, water-soluble.	Organic, water-insoluble.	Found.	Guaranteed.	Water-soluble.	Citrate-soluble.	Citrate-insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.
0.12	0.18	0.58	0.95	0.8	5.95	2.56	0.96	9.47	9.0	8.51	8.0	4.06	4.0
0.25	0.31	1.09	2.05	2.1	6.81	2.04	0.82	9.67	9.0	8.85	8.0	6.12	6.0
0.93	0.33	1.07	2.42	2.5	5.65	3.65	1.19	10.49	10.0	9.30	9.0	2.77	2.0
0.45	0.38	1.75	2.70	2.5	3.03	2.80	1.42	7.25	5.0	5.83	4.0	4.52	4.0
0.88	0.26	1.13	2.58	2.5	6.33	2.23	0.82	9.38	9.0	8.56	8.0	5.97	6.0
0.10	0.34	0.80	1.78	1.7	6.78	2.03	1.02	9.83	9.0	8.81	8.0	10.39	10.0
0.42	0.27	1.35	2.32	2.5	6.23	3.04	1.25	10.52	9.0	9.27	8.0	4.02	4.0
1.05	0.16	0.90	2.33	2.5	6.66	2.79	1.56	11.01	10.0	9.45	9.0	2.35	2.0
1.00	0.34	1.33	2.67	2.5	4.08	2.28	1.11	7.47	7.0	6.36	6.0	[1]9.29	10.0
0.90	0.45	1.33	2.68	2.5	4.89	2.80	1.28	8.97	7.0	7.69	6.0	[2]8.18	10.0
0.76	0.19	0.81	2.18	2.1	6.02	2.55	1.19	9.76	9.0	8.57	8.0	5.68	6.0
0.27	0.13	0.58	1.11	1.0	6.30	2.24	1.29	9.83	9.0	8.54	8.0	2.31	2.0
0.42	0.32	1.31	2.18	2.1	5.49	3.00	1.32	9.81	9.0	8.49	8.0	1.79	1.5
1.40	0.34	1.25	3.30	3.3	5.69	2.97	1.10	9.76	9.0	8.66	8.0	7.24	7.0
1.22	0.51	0.76	2.49	2.5	6.25	3.37	1.56	11.18	10.0	9.62	9.0	2.30	2.0
0.91	0.32	1.11	2.58	2.5	4.67	2.04	1.00	7.71	7.0	6.71	6.0	5.10	5.0
0.41	0.51	1.00	2.10	2.1	6.12	2.65	1.20	9.97	9.0	8.77	8.0	3.28	3.0
0.12	0.35	0.53	1.07	0.8	3.18	2.06	1.41	6.65	5.0	5.24	4.0	8.19	8.0
0.16	0.23	0.55	1.02	0.8	5.19	3.39	0.96	9.54	9.0	8.58	8.0	4.02	4.0
0.30	0.30	1.11	2.03	2.1	6.79	2.10	0.81	9.70	9.0	8.89	8.0	5.81	6.0
0.47	0.37	0.83	1.75	1.7	5.60	2.96	1.64	10.20	9.0	8.56	8.0	2.43	2.0
1.10	0.47	0.91	2.48	2.5	4.56	2.09	1.1[illegible]	7.78	7.0	6.65	6.0	[3]10.24	10.0
0.72	0.35	0.95	2.15	2.1	6.24	2.37	0.87	9.48	9.0	8.61	8.0	3.13	3.0

)% potash as muriate, 7.70% as sulphate. [2] 1.20% potash as muriate, 6.98% as sulph

NITROGENOUS SUPERPHOSPHATES.

Manufacturer and Brand.	Place of Sampling.	Dealers' average cash price per ton.	Valuation of the Plant Food in one ton, see p. 3.	Percentage difference
Sampled by Station Agent:				
Williams and Clark Branch:				
Americus Ammoniated Bone Superphosphate	Waterbury, Wapping	....	$20.35	
Americus Corn Phosphate	Milford, Wallingford, New Britain	$30.75	17.61	
Americus H. G. Special Fertilizer	Wapping	38.50	26.34	
Americus Potato Manure	Milford, Ellington, Wapping	32.00	18.74	
Potato Phosphate	Waterbury, Ellington, New Britain	34.00	19.54	
The Armour Fertilizing Works, Baltimore, Md.				
All Soluble	New Haven, Bridgeport, Willimantic	33.25	21.38	
Ammoniated Bone with Potash	Bridgeport, Willimantic	28.50	16.88	
Bidwell's Formula for all Crops	Windsor Locks	30.00	20.01	
Bidwell's Formula for all Crops	Windsor Locks	30.00	20.94	
Bone, Blood and Potash	Bridgeport	39.00	28.36	
Brewer's Special Fertilizer	East Hartford	36.00	25.92	
Complete Potato	Groton, Danielson	29.50	17.26	
Corn King	Groton, Silver Lane	31.50	19.88	
Fish and Potash Mixture	Danielson, Meriden	25.00	14.62	
Fruit and Root Crop Special	Danielson	28.00	17.98	
H. G. Potato	New Haven, Bridgeport, Willimantic	33.75	....	
Market Garden	New Haven	36.00	25.90	
Berkshire Fertilizer Co., Bridgeport, Conn.				
Ammoniated Bone Phosphate	Waterbury, Norwich Town, Stafford	28.25	15.00	
Complete Fertilizer	Waterbury, Milldale, Hazardville	34.75	23.39	
Grass Special	Norwich Town, Stafford, Windsor	36.25	25.81	
Long Island Special	Milldale, Wethersfield	35.50	24.08	
Potato and Vegetable Phosphate	Waterbury, Norwich Town, Stafford	32.00	18.77	
Tobacco Special with Carbonate	Hazardville	38.00	30.17	
F. E. Boardman, Middletown, Conn.				
Complete Fertilizer	Middletown	34.00	24.96	

* See note, p. 49. † See note, p. 50.

Analyses and Valuations—*Continued.*

	Nitrogen.					Phosphoric Acid.							Potash.	
				Total Nitrogen.					Total.		So-called "Available."			
	In Ammonia.	Organic, water-soluble.	Organic, water-insoluble.	Found.	Guaranteed.	Water-soluble.	Citrate-soluble.	Citrate-insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.
7	0.63	0.33	1.21	2.64	2.5	6.25	3.49	1.24	10.98	10.0	9.74	9.0	2.29	2.
9	0.25	0.29	1.31	2.14	2.1	5.43	3.44	1.56	10.43	9.0	8.87	8.0	1.74	1.
.	1.90	0.37	1.18	3.45	3.3	5.34	3.84	1.18	10.36	9.0	9.18	8.0	6.86	7.
5	0.55	0.45	1.01	2.16	2.1	6.04	2.59	1.02	9.65	9.0	8.63	8.0	3.47	3.
3	1.12	0.[illegible]	0.95	2.52	2.5	4.24	2.55	1.28	8.07	7.0	6.79	6.0	5.01	5.
6	0.25	0.51	0.88	3.00	2.9	5.65	2.36	0.92	8.93	8.5	8.01	8.0	4.04	4.
6	0.20	0.27	1.29	2.52	2.5	4.14	2.35	0.67	7.16	6.5	6.49	6.0	2.24	2.
.	0.07	0.66	1.32	2.05	2.5	5.95	2.34	0.93	9.22	8.5	8.29	8.0	[1] 4.59	5.
.	0.12	0.63	1.57	2.32	2.5	5.85	2.31	0.92	9.08	8.5	8.16	8.0	[2] 4.61	5.
4	0.20	0.39	1.37	4.40	4.1	4.01	3.58	1.13	8.72	8.5	7.59	8.0	7.11	7.
9	0.06	0.20	3.10	4.45	4.5	2.50	1.78	0.17	4.45	4.5	4.28	4.0	[3] 5.75	5.
2	0.10	0.17	0.86	1.85	1.7	4.62	2.24	0.65	7.51	7.5	6.86	7.0	5.21	6.
6	0.26	0.11	0.88	2.51	2.5	6.14	1.81	0.84	8.79	8.5	7.95	8.0	4.45	4.
.	0.18	0.42	1.24	1.84	2.1	3.75	2.82	0.52	7.09	6.5	6.57	6.0	2.20	2.
8	0.83	0.17	0.60	1.68	1.7	6.36	1.96	0.56	8.88	8.5	8.32	8.0	5.34	5.
1	0.10	0.00	1.19	1.80	1.7	5.30	2.69	1.00	8.99	8.5	7.99	8.0	10.26	10.
9	0.46	0.16	1.41	3.42	3.3	5.64	2.78	0.79	9.21	8.5	8.42	8.0	7.29	7.
2	....	0.10	1.11	1.33	0.8	6.16	2.34	0.58	9.08	9.0	8.50	8.0	2.78	2.
2	0.08	0.38	1.82	2.70	2.5	3.72	4.48	1.22	9.42	9.0	8.20	8.0	7.01	6.
7	0.05	0.07	1.55	5.44	5.0	2.61	2.57	0.67	5.85	5.0	5.18	4.0	2.78	2.
4	0.20	0.80	1.83	3.47	3.3	1.88	4.01	0.93	6.82	7.0	5.89	6.0	7.12	7.
5	0.06	0.13	1.41	2.55	1.7	4.59	1.77	0.31	6.67	7.0	6.36	6.0	4.60	4.
.	0.08	2.47	2.72	5.27	4.5	0.05	3.52	0.18	3.75	4.0	3.57	3.0	[4] 6.13	5.
8	0.05	0.37	1.51	3.21	3.0	1.66	4.96	0.84	7.46	....	6.62	7.0	8.98	9.

31% potash as muriate, 3.78% as sulphate. [2] 0.73% potash as muriate, 3.88% as sulp.
98% potash as muriate, 4.77% as sulphate.
00% potash as muriate, 3.28% as sulphate, 1.85% as carbonate.

NITROGENOUS SUPERPHOSPHATES.

Station No.	Manufacturer and Brand.	Place of Sampling.	Dealers' average cash price per ton.	Valuation of the Plant Food in one ton, see
	Sampled by Station Agent: **Bowker Fertilizer Co., New York City.**			
729	Complete Alkaline Tobacco Grower	East Windsor Hill	$38.00	$27.
730*	*Complete Alkaline Tobacco Grower with Carbonate*	West Suffield	36.50	26.
68	Complete Alkaline Tobacco Grower with Carbonate	West Suffield	36.50	29.
18	Corn Phosphate	Willimantic, Norwich	29.75	15.
47	Early Potato Manure	Yalesville, Silver Lane	37.00	25.
728	Farm and Garden Phosphate	Hazardville, Jewett City	29.50	15.
88	Fisherman's Brand Fish and Potash	Waterbury, Yalesville, Southington	29.7[illegible]	16.
82	Gloucester Fish and Potash	New Haven, Plainfield, Turnerville	25.00	13.
82	Hill and Drill Phosphate	Waterbury, Hazardville, Norwich	34.75	20.
731	Lawn and Garden Dressing	New Haven	....	21.
48	Market Garden Fertilizer	East Hartford, Yalesville, Wethersfield	37.00	23.
30	Potato and Vegetable Fertilizer	Hazardville, Rockville, E. Windsor Hill	33.75	20.
31	Special Crop Grower	Westport	32.00	21.
49	Sure Crop Phosphate	Yalesville, Willimantic	25.50	14.
97	Tobacco Starter	Rockville, New Milford	34.00	20.
57	Tobacco Ash *Elements*	*West Suffield*	32.50	20.
87	Stockbridge Sp'l Complete Manure for Corn and all Grain Crops	Meriden, New Britain, Bristol	38.00	27.
85*	Stockbridge Sp'l Complete Manure *for Potatoes and Vegetables*	New Haven, Waterbury, *Meriden*	35.50	25.
32	Stockbridge Sp'l Complete Manure for Potatoes and Vegetables	Westport	35.50	25.
50	Stockbridge Sp'l Complete Manure for Seeding Down, etc.	Yalesville, Yantic	38.50	23.
742*	Stockbridge Sp'l Complete Manure for Tobacco	Glastonbury	48.00	29.
96	Stockbridge Sp'l Complete Manure *for Tobacco*	*Cromwell*	*48.00*	33.
86	Stockbridge Sp'l Complete Manure for Top Dressing and for Forcing	New Haven, Meriden, New Britain	39.00	26.
	The Buffalo Fertilizer Co., Buffalo, N. Y.			
70†	Buffalo Tobacco Producer	Hazardville, Manchester Windsor Locks	40.25	27.

* See note, p. 50. † See note, p. 51.

Analyses and Valuations—*Continued.*

Nitrogen.						Phosphoric Acid.							Potash.	
				Total Nitrogen.					Total.		So-called "Available."			
	In Ammonia.	Organic, water-soluble.	Organic, water-insoluble.	Found.	Guaranteed.	Water-soluble.	Citrate-soluble.	Citrate-insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.
71	0.08	0.27	3.34	4.40	4.1	0.66	4.86	2.00	7.52	5.0	5.52	4.0	[1]5.56	5.
74	0.08	0.21	3.15	4.18	4.1	0.61	5.48	2.42	8.51	5.0	6.09	4.0	[2]4.09	5.
98	0.02	3.24		4.24	4.1	0.48	4.55	2.57	7.60	5.0	5.03	4.0	[3]6.22	5.
22	0.72	0.28	0.50	1.72	1.7	6.22	2.34	1.15	9.71	9.0	8.56	8.0	2.26	2.
89	1.11	0.22	1.13	3.35	3.3	4.71	2.68	1.36	8.75	8.0	7.39	7.0	7.48	7.
21	0.68	0.27	0.50	1.66	1.7	6.11	2.43	0.93	9.47	9.0	8.54	8.0	2.03	2.
..	0.93	0.52	1.02	2.47	2.5	2.02	2.42	1.96	6.40	5.0	4.44	4.0	4.08	4.
10	0.33	0.15	0.57	1.15	0.8	5.45	2.51	1 02	8.98	9.0	7.96	8.0	2.17	1.
54	0.96	0.19	0.96	2.75	2.5	6.77	2.36	1.41	10.54	10.0	9.13	9.0	2.37	2.
89	1.38	0.06	1.09	3.42	3.3	2.48	2.16	4.26	8.90	8.0	4.64	4.0	5.05	5.
99	0.50	0.18	0.95	2.62	2.5	3.54	3.05	1.19	7.78	7.0	6.59	6.0	9.74	10.
60	1.01	0.11	0.85	2.57	2.5	5.79	2.43	1.27	9.49	9.0	8.22	8.0	4.33	4.
12	1.00	0.18	0.58	1.88	1.6	6.12	1.77	0.43	8.32	9.0	7.89	8.0	9.11	10.
15	0.35	0.20	0.45	1.15	0.8	6.90	1.90	1.27	10.07	10.0	8.80	9.0	2.54	2.
71	0.89	0.30	0.70	2.60	2.5	5.00	3.40	2.10	10.50	9.0	8.40	8.0	[4]3.77	3.
..	....	....	....	0.27	....	0.95	5.33	2.15	8.43	9.0	6.28	6.0	[5]13.48	15.
56	2.09	0.00	0.78	3.43	3.3	9.48	1.35	0.38	11.21	11.0	10.83	10.0	7.17	7.
57	1.36	0.02	1.18	3.23	3.3	4.65	2.39	0.99	8.03	7.0	7.04	6.0	9.30	10.
97	0.94	0.20	1.14	3.25	3.3	4.26	2.44	1.05	7.75	7.0	6.70	6.0	9.39	10.
03	0.43	0.20	1.00	2.66	2.5	3.39	3.32	1.30	8.01	9.0	6.71	6.0	9.53	10.
24	1.25	0.27	1.70	3.46	5.8	0.96	3.86	1.00	5.82	5.0	4.82	4.0	[6]12.45	10.
49	2.90	0.93		5.32	5.8	2.54	3.25	1.46	7.25	5.0	5.79	4.0	[7]9.83	10.
35	1.05	0.16	2.06	4.62	4.9	1.89	3.31	1.18	6.38	6.0	5.20	4.0	6.28	6.
..	2.14	0.23	2.17	4.54	4.5	4.08	1.68	0.41	6.17	6.0	5.76	5.0	[8]5.99	5.

[1] 0.80% potash as muriate, 4.76% as sulphate.
[2] 0.51% potash as muriate, 1.42% as sulphate,
[4] 0.90% potash as muriate, 2.87% sulphate.

NITROGENOUS SUPERPHOSPHATES.

Station No.	Manufacturer and Brand.	Place of Sampling.	Dealers' average cash price per ton.	Valuation of the Plant Food in one ton, see p. 3.
	Sampled by Station Agent: **The Buffalo Fertilizer Co., Buffalo, N. Y.** *(Continued.)*			
0*	Celery and Potato Special	W. Cheshire, Hazardville, Manchester	$34.00	$21.7
7	Celery and Potato Special	Torrington	34.00	22.2
0	Farmers' Choice	Manchester, Ansonia, Branford	25.75	15.8
3	Fish Guano	Manchester, Plainfield, Moosup	26.25	15.0
3	High Grade Manure	Hazardville, Torrington	38.75	27.6
9	New England Special	W. Cheshire, Hazardville, Manchester	29.25	19.0
8*	Top Dresser	W. Cheshire, New Canaan	43.00	28.0
4	Vegetable and Potato	Norwich Town	33.00	21.7
	The E. D. Chittenden Co., Bridgeport, Conn.			
9	Complete Tobacco and Onion Grower	Rockville, Green's Farms	34.50	25.8
4†	Connecticut Tobacco Grower	Broad Brook (2), Windsorville	47.00	32.3
5	Fish and Potash	Windsorville, Rockville	29.00	25.9
8	Grain and Vegetable	Green's Farms	33.00	24.5
7	Grass and Grain	Rockville	37.00	24.9
9	Potato and Grain	Rockville, Broad Brook	36.00	25.2
6	Potato Manure	Windsorville, Warehouse Point	34.00	26.9
9	Tobacco Special	Broad Brook, Windsorville, Scitico	35.00	26.2
	The Everett B. Clark Seed Co., Milford, Conn.			
1	Special Mixture	Milford	32.00	26.48
2	Special 10%	Milford (2)	34.00	28.47
	The Coe-Mortimer Co., New York City.			
0	Celebrated Special Potato Fertilizer	Bristol, W. Hartford	31.50	18.29
1‡	Complete Manure 10% Potash	Suffield, Bristol, Torrington	36.50	24.88
3	Gold Brand Excelsior Guano	Suffield, Bristol, W. Hartford	35.50	21.95
[illegible]	H. G. Ammoniated Bone Superphosphate	Suffield, Bristol, W. Hartford	30.50	18.08
[illegible]	New Englander Corn and Potato Fertilizer	W. Hartford, Winsted	32.00	13.92
3‡	Peruvian Tobacco Fertilizer	Somersville, So. Manchester	49.00	32.42
[illegible]‡	Peruvian Vegetable Grower	West Cheshire, Bristol	42.00	27.38

ANALYSES AND VALUATIONS—*Continued.*

	Nitrogen.					Phosphoric Acid.							Potash.	
				Total Nitrogen.					Total.		So-called "Available."			
	In Ammonia.	Organic, water-soluble.	Organic, water-insoluble.	Found.	Guaranteed.	Water-soluble.	Citrate-soluble.	Citrate-insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.
7	0.44	0.01	0.53	1.85	1.6	5.34	3.14	1.52	10.00	9.0	8.48	8.0	8.71	10.
2	0.10	0.17	0.65	1.54	1.6	6.12	2.50	1.29	9.91	9.0	8.62	8.0	10.21	10.
8	0.25	0.20	0.52	1.05	0.8	4.84	3.55	1.47	9.86	9.0	8.39	8.0	4.94	5.
6	0.25	0.17	0.57	1.15	0.8	4.88	4.33	1.47	10.68	10.0	9.21	9.0	2.91	2.
4	0.65	0.18	0.94	3.31	3.3	5.17	2.84	1.87	9.88	8.0	8.01	7.0	10.03	10.
1	0.75	0.06	0.53	1.75	1.6	5.92	3.06	1.89	10.87	10.0	8.98	9.0	5.26	5.
3	1.25	0.25	0.88	4.91	5.7	2.83	4.23	1.52	8.58	7.0	7.06	6.0	5.52	5.
0	0.69	0.12	0.42	2.63	2.4	3.51	4.54	1.07	9.12	9.0	8.05	8.0	6.56	7.
8	1.88	0.12	1.15	3.33	3.3	8.18	0.86	0.27	9.31	10.0	9.04	8.0	[1]5.84	5.
7	2.02	0.05	2.46	4.80	5.0	3.61	0.83	0.17	4.61	6.0	4.44	4.0	[2]10.81	8.
5	1.95	0.00	1.26	3.36	2.5	7.54	0.83	0.32	8.69	6.0	8.37	....	[3]6.37	4.
1	1.57	0.05	1.38	3.21	2.5	7.74	0.87	0.13	8.74	10.0	8.61	8.0	[4]5.48	6.
6	0.28	0.66	1.14	4.04	4.0	4.24	2.70	0.63	7.57	8.0	6.94	6.0	5.27	5.
8	2.16	0.20	0.56	3.70	3.3	6.62	1.30	0.19	8.11	10.0	7.92	8.0	6.56	6.
5	1.94	0.15	1.24	3.48	2.0	7.21	1.10	0.24	8.55	10.0	8.31	8.0	[5]7.04	6.
8	1.95	0.60	1.83	4.56	4.3	2.86	0.74	0.15	3.75	5.0	3.60	3.0	[6]6.54	5.
7	1.28	0.05	0.89	3.39	3.3	6.24	2.74	1.00	9.98	....	8.98	8.0	7.78	7.
9	1.39	0.00	1.04	3.52	3.3	4.72	2.99	1.19	8.90	....	7.71	6.0	10.84	10.
1	0.16	0.25	0.98	1.80	1.7	5.95	2.77	1.42	10.14	9.0	8.72	8.0	4.22	4.
4	1.04	0.23	1.11	2.52	2.5	5.15	2.71	1.93	9.79	7.0	7.86	6.0	9.79	10.
0	1.60	0.34	1.10	2.54	2.5	6.26	2.36	0.97	9.59	9.0	8.62	8.0	5.81	6.
4	0.46	0.38	1.02	2.00	1.9	5.95	2.69	1.25	9.89	9.0	8.64	8.0	3.26	3.
5	0.10	0.22	0.28	1.05	0.8	5.07	2.73	1.33	9.13	8.5	7.80	7.5	3.45	3.
3	0.34	0.42	2.37	4.56	5.0	2.78	4.50	0.36	7.64	7.0	7.28	6.0	[7]9.62	10.
0	0.50	0.48	1.02	3.20	3.3	5.88	2.69	0.81	9.38	9.0	8.57	8.0	[8]8.43	9.

1% potash as muriate. 5.33% as sulphate. [6] 0.40% potash as muriate. 6.64% as sulp

NITROGENOUS SUPERPHOSPHATES.

Manufacturer and Brand.	Place of Sampling.	Dealers' average cash price per ton.	Valuation of the Plant Food in one ton, see p. 3.	Percentage difference
Sampled by Station Agent:				
The Coe-Mortimer Co., New York City. *(Continued.)*				
Red Brand Excelsior Guano	West Cheshire, Bristol, Somersville	$37.75	$26.50	[illegible]
Tobacco and Onion Fertilizer	Canton	32.00	26.96	[illegible]
Conn. Valley Orchard Co., Berlin, Conn.				
H. G. Special Fertilizer	Berlin	27.00	21.88	[illegible]
T. H. Eldredge, Norwich, Conn.				
Special Fish and Potash	Norwich	30.00	18.91	[illegible]
Special Superphosphate	Norwich	28.00	15.93	[illegible]
Essex Fertilizer Co., Boston, Mass.				
Complete Manure for Corn, Grain and Grass	East Hartford, Plainville	41.50	25.94	[illegible]
Complete Manure for Potatoes, Roots and Vegetables	Suffield, East Hartford, Plainville	39.25	25.91	[illegible]
Market Garden and Potato Manure	East Hartford, Windsor Locks, Plainville	36.00	20.41	[illegible]
Special Tobacco Manure	East Hartford, Hazardville	44.50	32.46	[illegible]
Tobacco Starter and Grower	Suffield, East Hartford, Poquonock	39.00	26.35	[illegible]
XXX Fish and Potash	Suffield, East Hartford, Plainville	32.00	17.37	[illegible]
Fertilizer Materials Supply Co., New York City.				
No. 1 Potato and General Truck Fertilizer	*Westport*	*32.00*	*24.29*	3
The L. T. Frisbie Co., New Haven, Conn.				
Connecticut Special Fertilizer	Hartford, Wallingford, Rockville	36.50	22.99	5
Connecticut Special Fertilzer	Torrington	36.50	21.58	6
Corn and Grain Fertilizer	Hartford, Wallingford, Bristol	30.00	18.19	6
Corn and Grain Fertilizer	New Haven	30.00	18.10	6
Potato Manure	New Haven, Hartford, Wallingford	33.00	21.63	5
Top Dressing	Rockville	39.00	26.06	4
Vegetable Grower	New Haven, Hartford, Winsted	35.00	26.36	3

* See note, p. 5

ANALYSES AND VALUATIONS—*Continued.*

Nitrogen.					Phosphoric Acid.							Potash.	
			Total Nitrogen.					Total.		So-called "Available."			
In Ammonia.	Organic, water-soluble.	Organic, water-insoluble.	Found.	Guaranteed.	Water-soluble.	Citrate-soluble.	Citrate-insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.
1.26	0.35	1.48	3.40	3.3	6.26	2.66	1.01	9.93	9.0	8.92	8.0	7.31	7.0
1.52	0.26	1.38	3.30	3.0	5.18	1.75	0.96	7.89	7.0	6.93	6.0	[1]8.54	8.0
0.78	0.34	1.42	2.62	2.5	7.13	2.67	1.07	10.87	10.0	9.80	9.0	3.97	4.0
0.21	0.65	1.58	2.44	2.1	2.14	3.54	2.15	7.83	6.0	5.68	5.0	4.36	4.0
0.06	0.28	0.91	1.33	1.0	4.07	4.69	2.96	11.72	10.0	8.76	8.0	2.78	2.0
0.05	0.77	1.33	3.16	3.3	4.69	1.94	0.55	7.18	7.0	6.63	6.0	9.96	10.0
0.10	0.87	1.10	3.14	3.3	4.56	1.89	0.47	6.92	7.0	6.45	6.0	10.30	10.0
0.06	0.98	0.61	2.09	2.0	6.85	1.98	1.52	10.35	9.0	8.83	8.0	5.13	5.0
0.10	0.91	1.45	3.93	4.1	3.51	4.84	1.10	9.45	7.0	8.35	6.0	[2]10.53	10.0
0.08	0.72	1.18	4.02	4.1	2.04	4.40	1.06	7.50	5.0	6.44	4.0	[3]6.22	6.0
0.06	0.50	0.76	2.02	2.0	6.18	2.05	0.47	8.70	9.0	8.23	8.0	3.15	3.0
1.97	0.00	0.79	3.21	3.3	6.98	1.50	0.88	9.36	....	8.48	8.0	6.44	7.0
0.07	0.88	1.23	2.54	2.5	3.89	2.11	0.27	6.27	7.0	6.00	6.0	9.71	10.0
0.05	0.74	1.20	2.34	2.5	3.86	2.02	0.27	6.15	7.0	5.88	6.0	9.03	10.0
0.55	0.54	0.69	1.88	1.5	4.41	5.11	2.39	11.91	9.0	9.52	8.0	2.76	3.0
0.50	0.55	0.83	2.00	1.6	5.78	3.14	1.20	10.12	9.0	8.92	8.0	3.08	3.0
0.79	0.73	0.96	2.48	2.5	4.97	3.02	0.75	8.74	8.0	7.99	7.0	6.37	6.0
0.04	1.44	2.17	4.12	4.1	4.43	3.72	0.83	8.98	8.0	8.15	7.0	3.95	4.0
1.60	0.77	1.00	3.47	3.3	4.30	3.26	1.14	8.70	8.0	7.56	6.0	8.33	8.0

3% potash as muriate, 7.76% as sulphate. [2] 1.10% potash as muriate, 9.43% as sulph
[3] 0.90% potash as muriate, 5.32% as sulphate.

NITROGENOUS SUPERPHOSPHATES.

	Manufacturer and Brand.	Place of Sampling.	Dealers' average cash price per ton.	Valuation of the Plant Food in one ton, see p. 3.
	Sampled by Station Agent:			
	Lister's Agricultural Chemical Works, Newark, N. J.			
	Ammoniated Dissolved Bone Phosphate	No. Branford	$30.00	$18.30
	Complete Tobacco Manure	Warehouse Pt., Glastonbury	37.00	23.85
	Complete Tobacco Manure with Carbonate	Burnside, Glastonbury	39.00	27.85
	Corn and Potato Fertilizer	Stafford, Danbury	30.50	18.08
	Potato Manure	Warehouse Pt., Hamden, Burnside	36.75	25.60
	Special Grass Mixture	Warehouse Pt., Glastonbury	36.00	24.99
*	Special 10% Fertilizer	Manufacturer's sample	....	24.04
	Standard Pure Bone Superphosphate of Lime	Burnside	32.00	20.05
	Success Fertilizer	Warehouse Pt., Hamden, Moodus	29.25	15.81
	3-6-10 for Potatoes	Glastonbury	36.00	24.58
	E. Manchester & Sons, Winsted, Conn.			
*	Formula	So. Wethersfield, Winsted, Simsbury	31.25	26.06
	Formula	Wethersfield	30.00	25.16
	Formula	Winsted	32.00	25.78
	Helper	Winsted, Wethersfield	27.00	21.37
*	Special	So. Wethersfield, Winsted	35.00	28.68
	The Mapes Formula and Peruvian Guano Co., New York City.			
	Average Soil Complete Manure	Windsor Locks, Southington, Hartford	37.75	26.95
	Cereal Brand	Hartford, Hazardville	30.00	18.28
	Complete Manure "A" Brand	Meriden, Southington, Hartford	36.00	22.15
	Corn Manure	Windsor Locks, Meriden, Southington	36.25	22.58
	Dissolved Bone	Hartford	33.00	22.98
	Economical Potato Manure	Southington, Hartford	37.50	26.48
	Fruit and Vine Manure	Southington, Hartford	41.50	25.62
	Potato Manure	Windsor Locks, Suffield, Meriden	40.75	27.19

* See note, p. 54.

Analyses and Valuations—*Continued.*

	Nitrogen.					Phosphoric Acid.							Potash.	
				Total Nitrogen.					Total.		So-called "Available."			
	In Ammonia.	Organic, water-soluble.	Organic, water-insoluble.	Found.	Guaranteed.	Water-soluble.	Citrate-soluble.	Citrate-insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.
5	0.34	0.67	1.12	2.28	2.1	5.05	3.97	1.64	10.66	9.0	9.02	8.0	1.75	1.:
9	0.10	0.39	0.82	4.00	4.1	1.78	2.61	1.55	5.94	5.0	4.39	4.0	[1]5.62	5.(
2	0.00	0.37	1.20	4.19	4.1	0.32	3.43	3.40	7.15	5.0	3.75	4.0	[2]5.99	5.(
.	0.20	0.74	1.04	1.98	1.7	4.93	3.23	2.33	10.49	9.0	8.16	8.0	3.19	3.(
9	1.70	0.35	0.73	3.27	3.3	6.43	2.02	1.61	10.06	9.0	8.45	8.0	7.32	7.(
1	1.09	0.32	0.38	1.90	1.0	9.26	1.34	0.50	11.10	....	10.60	10.0	10.32	10.(
6	0.59	0.57	0.90	2.12	1.6	5.17	2.25	1.61	9.03	....	7.42	8.0	10.83	10.(
4	1.13	0.63	0.85	2.65	2.5	6.77	2.75	1.25	10.77	10.0	9.52	9.0	2.09	2.(
2	0.14	0.58	0.60	1.44	1.2	6.73	2.59	1.37	10.69	10.0	9.32	9.0	2.10	2.(
.	1.07	0.49	0.97	2.53	2.5	4.11	2.70	1.47	8.28	7.0	6.81	6.0	10.65	10.(
6	1.34	0.25	1.39	3.44	3.5	5.77	2.65	0.93	9.35	....	8.42	7.5	7.30	8.c
8	1.15	0.12	1.25	3.20	3.5	5.54	2.57	1.05	9.16	....	8.11	7.5	7.58	8.c
0	1.32	1.66		3.18	3.5	5.94	2.18	1.15	9.27	....	8.12	7.5	8.13	8.c
0	0.14	0.37	0.93	1.74	1.6	6.36	2.11	1.32	9.79	....	8.47	8.0	8.28	8.c
3	4.11	0.00	0.50	4.64	5.0	6.59	1.31	0.47	8.37	....	7.90	7.5	[3]5.78	7.5
)	0.18	0.34	0.70	4.42	4.1	1.57	6.32	0.63	8.52	8.0	7.89	7.0	[4]5.04	5.0
)	0.34	0.12	0.78	2.24	1.7	0.64	6.93	1.32	8.89	8.0	7.57	6.0	4.46	3.0
5	0.33	0.14	0.47	2.99	2.5	0.97	9.44	2.33	12.74	12.0	10.41	10.0	3.08	2.5
4	0.19	0.15	0.82	2.70	2.5	0.85	7.86	1.47	10.18	10.0	8.71	8.0	6.50	6.0
-	0.20	0.75	1.47	2.42	2.1	3.67	12.72	1.01	17.40	....	16.39	12.0	....	....
9	0.42	0.07	0.83	3.61	3.3	0.55	5.63	0.70	6.88	6.0	6.18	4.0	[5]8.60	8.0
3	0.12	0.07	0.86	2.28	1.7	0.40	5.84	1.18	7.42	7.0	6.24	5.0	[6]11.82	10.0
3	0.10	0.00	0.44	3.67	3.7	1.27	7.36	0.79	9.42	8.0	8.63	8.0	[7]7.32	6.0

0% potash as muriate, 4.72% as sulphate.
0% potash as muriate, 0.54% as sulphate,
.85% as carbonate.
0% potash as muriate, 5.18% as sulphate.

[4] 0.80% potash as muriate, 4.24% as sulpl
[5] 1.00% potash as muriate, 7.60% as sulpl
[6] 1.40% potash as muriate, 10.42% as sulpl
[7] 0.85% potash as muriate, 6.47% as sulpl

NITROGENOUS. SUPERPHOSPHATES.

Manufacturer and Brand.	Place of Sampling.	Dealers' average cash price per ton.	Valuation of the Plant Food in one ton, see p. 3.	Percentage difference.
Sampled by Station Agent:				
The Mapes Formula and Peruvian Guano Co., New York City. *(Continued.)*				
Seeding Down Manure	Hartford	$42.00	$33.12	2
Tobacco Ash Constituents	Hartford, Windsor Locks, Suffield	34.75	28.00	2
Tobacco Manure, Wrapper Brand	Hartford, Broad Brook, Windsor Locks	49.25	41.81	1
Tobacco Starter, Improved	Windsor Locks, Suffield, Hartford	37.75	26.40	4
Top Dresser, Imp'd, Full Strength	Hartford, Forestville	53.00	44.59	1
Top Dresser, Imp'd, Half Strength	Windsor Locks, Middletown, Hartford	34.75	21.78	5
Vegetable Manure for Light Soils	Meriden, Hartford	43.00	31.36	3
The National Fertilizer Co., New York City.				
Ammoniated Bone Phosphate	Willimantic, Silver Lane, Winsted	28.25	16.67	6
Complete Grass Fertilizer	So. Manchester, Greenwich	38.00	23.66	6
Complete Grass Fertilizer	Chester	38.00	24.58	5
Complete Root and Grain Fertilizer	So. Manchester, Silver Lane	38.50	24.45	5
Complete Tobacco Fertilizer	East Windsor Hill, New Milford	36.75	24.49	5
Eureka Potato Fertilizer	So. Manchester, Willimantic, Guilford	35.75	22.96	5
Eureka Potato Fertilizer	Chester	35.75	23.70	5
Fish and Potash	West Cheshire, So. Manchester, Silver Lane	30.25	20.05	5
Formula "A"	Willimantic	35.00	22.28	5
Market Garden Fertilizer	Greenwich, Chester	36.00	22.29	6
Potato Phosphate *	So. Manchester, Willimantic, Silver Lane	32.00	20.76	5
Tobacco Special	So. Manchester, Warehouse Pt., New Milford	37.25	27.15	3
Tobacco Special with Carbonate	So. Manchester, Warehouse Pt.	40.00	27.66	4
XXX Fish and Potash	So. Manchester, No. Branford, Guilford	28.75	17.21	6

* See note, p. 54.

Analyses and Valuations—*Continued.*

Nitrogen: In Ammonia.	Nitrogen: Organic, water-soluble.	Nitrogen: Organic, water-insoluble.	Total Nitrogen: Found.	Total Nitrogen: Guaranteed.	Phosphoric Acid: Water-soluble.	Phosphoric Acid: Citrate-soluble.	Phosphoric Acid: Citrate-insoluble.	Phosphoric Acid, Total: Found.	Phosphoric Acid, Total: Guaranteed.	So-called "Available": Found.	So-called "Available": Guaranteed.	Potash: Found.	Potash: Guaranteed.
0.02	0.12	0.38	3.38	2.5	0.08	12.97	4.95	18.00	18.0	13.05	....	10.92	10.0
0.07	0.74		1.12	0.5	0.17	1.90	3.98	6.05	5.7	2.07	....	[1] 15.17	15.0
0.07	0.44	2.33	6.90	6.2	0.12	4.26	1.20	5.58	4.5	4.38	....	[2] 10.13	10.5
0.21	0.29	1.42	4.86	4.1	0.27	7.13	4.38	11.78	8.0	7.40	6.0	[3] 1.97	1.0
3.38	0.55	0.27	10.14	9.9	0.38	6.45	0.63	7.46	8.0	6.83	5.0	[4] 4.90	4.0
1.40	0.07	0.16	4.97	4.9	0.33	2.66	0.99	3.98	4.0	2.99	2.5	[5] 2.41	2.0
0.10	0.13	0.79	5.14	4.9	0.89	7.15	0.56	8.60	8.0	8.04	6.0	[6] 7.05	6.0
0.45	0.27	0.80	1.74	1.7	6.41	2.23	1.71	10.35	9.0	8.64	8.0	2.53	2.0
0.60	0.24	1.80	3.62	4.1	5.87	1.32	0.32	7.51	7.0	7.19	6.0	4.98	5.0
0.67	0.33	1.96	3.80	4.1	5.05	1.74	0.55	7.34	7.0	6.79	6.0	5.58	5.0
1.00	0.18	1.66	3.20	3.3	6.25	2.13	0.69	9.07	9.0	8.38	8.0	6.30	6.0
1.45	0.31	1.39	3.15	3.3	6.70	2.18	0.87	9.75	9.0	8.88	8.0	[7] 5.17	5.0
0.70	0.20	1.15	2.61	2.5	3.89	2.62	0.87	7.38	7.0	6.51	6.0	9.08	10.0
0.38	0.29	1.60	2.82	2.5	4.06	3.09	1.01	8.16	7.0	7.15	6.0	8.15	10.0
0.85	0.19	1.55	2.73	2.9	5.11	1.48	1.20	7.79	7.0	6.59	6.0	4.60	4.0
1.24	0.59	1.12	3.43	3.3	4.07	1.61	0.49	6.17	7.0	5.68	6.0	5.83	6.0
0.65	0.16	1.37	2.53	2.5	6.65	1.91	0.83	9.39	9.0	8.56	8.0	6.26	6.0
0.50	0.19	0.91	2.10	2.1	6.31	2.39	1.00	9.70	9.0	8.70	8.0	6.22	6.0
0.16	0.34	3.80	4.60	4.6	1.41	2.88	1.04	5.33	4.0	4.29	3.0	[8] 5.74	5.5
0.05	3.39	1.10	4.54	4.6	0.41	3.04	2.23	5.68	4.0	3.45	3.0	[9] 5.08	5.5
0.65	0.18	1.03	2.45	2.5	3.88	1.84	0.92	6.64	6.0	5.72	5.0	3.74	3.0

% potash as muriate, 2.86% as sulphate, .61% as carbonate.
% potash as muriate, 2.20% as sulphate, .14% as carbonate.
% potash as muriate, 0.72% as sulphate.
% potash as muriate, 4.00% as sulphate.
[5] 0.45% potash as muriate, 1.96% as sulph
[6] 1.10% potash as muriate, 5.95% as sulph
[7] 1.50% potash as muriate, 3.[illegible]% as sulph
[8] 0.60% potash as muriate, 5.14% as sulph
[9] 0.51% potash as muriate, 1.82% as sulph 2.75% as carbonate.

NITROGENOUS SUPERPHOSPHATES.

Station No.	Manufacturer and Brand.	Place of Sampling.	Dealers' average cash price per ton.	Valuation of the Plant Food in one ton, see p. 3.
	Sampled by Station Agent:			
	New England Fertilizer Co., Boston, Mass.			
4	Corn and Grain Fertilizer..........	Plantsville, Rockville.....	$29.00	$13.9
7	Corn Phosphate..................	Jewett City..............	31.00	16.7
8	H. G. Potato Fertilizer............	Plantsville................	35.00	20.9
6	Perfect Tobacco Grower...........	Warehouse Pt., Glastonbury	36.75	26.2
5	Potato Fertilizer.................	Plantsville, Rockville	31.00	17.0
9	Potato Grower	Rockville.................	38.00	22.7
6	Superphosphate	Plantsville, Wallingford, Middlefield	32.25	20.2
	The Niantic Menhaden Oil and Guano Co., South Lyme, Conn.			
7	Bone, Fish and Potash............	Windsor Locks, Norwich, Suffield.............	30.25	23.5
1	Corn and Grain Fertilizer..........	Norwich, East Haddam....	32.50	20.3
3	*H. G. Tobacco Fertilizer*...........	*East Haddam, Silver Lane.*	34.50	27.4
0	Market Garden Manure............	Norwich, Moodus.........	36.00	27.5
6	Potato and Vegetable Manure......	Norwich, Suffield..........	32.50	23.1
	Olds & Whipple, Hartford, Conn.			
5	Complete Corn and Potato Fertilizer	Hartford..................	34.00	25.3
6	Complete Grass Fertilizer	Hartford..................	34.00	25.0
7	Complete Tobacco Fertilizer	Hartford..................	37.00	31.5
8	Fish and Potash..................	Hartford..................	30.00	19.6
9	H. G. Potato Fertilizer........	Hartford	37.00	28.6
5	Special Phosphate................	Hartford..................	35.00	25.6
7*	Vegetable Ash and Bone...........	Hartford..................	44.00	34.3
	Parmenter & Polsey Fertilizer Co., Boston, Mass.			
4	Grain Grower.....................	Plantsville................	32.00	12.68
2	Plymouth Rock Brand.............	Plantsville, Plainville, E. Hampton...............	34.25	19.21
5	Potato Fertilizer..................	Plantsville................	34.00	16.61
6	Potato Grower	East Hampton............	38.00	23.02
7	Special Tobacco Grower............	Warehouse Pt., Wallingford	38.00	27.50
	The Frank S. Platt Co., New Haven, Conn.			
6	Platco Market Garden Phosphate..	New Haven...............	35.00	21.46

* See note, p. 55.

ANALYSES AND VALUATIONS—*Continued.*

Nitrogen: In Ammonia.	Nitrogen: Organic, water-soluble.	Nitrogen: Organic, water-insoluble.	Total Nitrogen: Found.	Total Nitrogen: Guaranteed.	Phosphoric Acid: Water-soluble.	Phosphoric Acid: Citrate-soluble.	Phosphoric Acid: Citrate-insoluble.	Total: Found.	Total: Guaranteed.	So-called "Available": Found.	So-called "Available": Guaranteed.	Potash: Found.	Potash: Guaranteed.
0.04	0.94	0.46	1.44	1.2	4.85	2.56	0.61	8.02	8.0	7.41	7.0	2.11	2.0
0.05	0.72	0.85	1.78	1.6	5.94	2.12	0.72	8.78	9.0	8.06	8.0	3.25	3.0
0.08	0.31	0.87	2.42	2.5	6.71	1.85	0.42	8.98	9.0	8.56	8.0	5.46	6.0
0.03	0.65	1.05	3.88	4.1	2.01	4.46	1.18	7.65	5.0	6.47	4.0	[1]6.63	6.0
0.36	0.57	0.71	1.74	1.6	4.72	3.07	0.72	8.51	8.0	7.79	7.0	4.27	4.0
0.28	0.43	0.88	2.45	2.5	4.68	1.53	0.38	6.59	7.0	6.21	6.0	9.88	10.0
0.06	0.77	0.69	2.54	2.5	6.34	1.89	0.81	9.04	9.0	8.23	8.0	4.17	4.0
0.40	0.53	1.70	3.13	2.5	2.91	3.46	1.28	7.65	6.0	6.37	5.0	[2]6.03	3.0
0.23	0.47	1.27	2.44	2.1	4.68	3.03	0.70	8.41	8.0	7.71	7.0	[3]4.39	3.5
0.22	0.36	1.94	3.68	3.3	5.58	2.57	0.88	9.03	8.0	8.15	7.0	[4]6.53	6.0
0.22	0.34	2.02	3.82	4.1	5.77	2.36	0.65	8.78	8.0	8.13	7.0	[5]6.23	6.0
0.25	0.51	1.46	3.00	2.5	4.94	3.82	0.72	9.48	8.0	8.76	7.0	[6]4.36	4.0
0.79	0.49	2.26	3.54	3.3	0.20	6.68	1.56	8.44	7.0	6.88	6.0	[7]6.24	6.0
0.20	0.51	2.36	3.60	3.3	0.52	5.80	1.13	7.45	7.0	6.32	6.0	[8]5.96	6.0
0.10	1.69	2.33	4.70	4.5	0.11	4.46	0.61	5.18	3.5	4.57	3.0	[9]6.81	5.5
0.26	0.75	1.81	2.82	2.5	2.73	3.40	0.42	6.55	6.0	6.13	5.0	4.31	3.0
1.23	0.50	1.95	3.68	3.3	0.66	6.13	0.99	7.78	7.0	6.79	6.0	[10]10.24	10.0
1.50	0.77	2.34	4.61	4.1	3.03	2.67	0.61	6.31	....	5.70	4.0	[11]3.76	3.0
....	....	....	....	....	0.20	11.22	0.17	11.59	....	11.42	12.0	[12]16.76	15.0
0.06	0.67	0.48	1.21	1.2	4.72	2.64	0.65	8.01	8.0	7.36	7.0	1.75	2.0
0.18	0.75	0.68	2.42	2.5	6.30	1.70	0.64	8.64	9.0	8.00	8.0	3.80	4.0
0.04	0.74	0.68	1.46	1.6	3.75	3.09	0.43	7.27	7.0	6.84	6.0	5.95	6.0
0.18	0.41	0.90	2.48	2.5	4.81	1.53	0.36	6.70	7.0	6.34	6.0	9.99	10.0
0.05	0.55	1.17	4.10	4.1	1.69	4.18	1.05	6.92	5.0	5.87	4.0	[13]7.65	8.0
1.07	0.27	1.04	2.80	2.5	6.52	2.08	1.23	9.83	9.0	8.60	8.0	4.17	4.0

…% potash as muriate, 5.63% as sulphate.
…% potash as muriate, 5.23% as sulphate.
…3% potash as muriate, 4.11% as sulphate.
…1% potash as muriate, 6.02% as sulphate.
…5% potash as muriate, 5.78% as sulphate.
…% potash as muriate, 3.96% as sulphate.
…% potash as muriate, 4.11% as sulphate.

[9] 0.40% potash as muriate, 0.79% as sulph… 5.62% as carbonate.
[10] 6.68% potash as muriate, 3.56% as sulph…
[11] 0.70% potash as muriate, 3.06% as sulph…
[12] 1.05% potash as muriate, 1.73% as sulph… 13.98% as carbonate.
[13] [illegible] potash as muriate, [illegible] as sulph…

NITROGENOUS SUPERPHOSPHATES.

Manufacturer and Brand.	Place of Sampling.	Dealers' average cash price per ton.	Valuation of the Plant Food in one ton, see p. 3.
Sampled by Station Agent:			
The Rogers & Hubbard Co., Middletown, Conn.			
"Bone Base" Complete Phosphate	Wallingford, Bristol, Somersville	$28.25	$18.35
"Bone Base" Fruit, or Grass and Grain Fertilizer	Middletown	44.00	31.98
"Bone Base" New Market Garden Phosphate	New Britain, Granby	36.00	23.69
"Bone Base" Oats and Top Dressing	Middletown	55.00	43.27
"Bone Base" Potato Phosphate	New Britain, Granby, Glastonbury	34.00	21.67
"Bone Base" Soluble Corn and General Crops Manure	New Canaan, East Hampton, Somersville	36.75	23.75
"Bone Base' Soluble Potato Manure	East Hampton, Glastonbury, Suffield	44.00	31.30
* "Bone Base" Soluble Tobacco Manure	Wallingford, Granby, Glastonbury	48.50	36.48
The Rogers Mfg. Co., Rockfall, Conn.			
All Round Fertilizer	Brooklyn, Rockfall	30.00	18.14
† Carbonate Formula for Tobacco	Suffield	33.50	28.78
Complete Potato and Vegetable Fertilizer	Wapping	32.50	21.98
Fish and Potash	Wapping, Warehouse Pt.	28.50	21.53
H. G. Complete Corn and Onion Manure	Suffield, Somersville	37.25	26.28
H. G. Grass and Grain	Rockfall, So. Manchester	42.25	35.38
H. G. Oats and Top Dressing	Suffield	45.00	36.21
H. G. Soluble Tobacco Manure	Glastonbury, Thompsonville	43.50	35.75
H. G. Tobacco and Potato Manure	Suffield, Somersville	40.25	30.69
H. G. Tobacco Grower	Burnside, Glastonbury	39.00	29.31
Tobacco Grower, Vegetable and Carbonate Formula	Suffield, Glastonbury	39.75	30.11
F. S. Royster Guano Co., Baltimore, Md.			
Ammoniated Potato Manure	No. Granby, Torrington	33.25	19.68
Champion Crop Compound	Pomfret Center	30.00	17.33
Fish and Potash	Torrington, Pomfret Center, No. Haven	28.00	16.28
Garden and Truck Guano	Torrington, Marbledale	32.00	21.16
General Crop Fertilizer	Killingly, Marbledale	24.75	15.49

* See note, p. 55. † See note, p. 56.

ANALYSES AND VALUATIONS—*Continued.*

	Nitrogen.					Phosphoric Acid.							Potash.	
				Total Nitrogen.					Total.		So-called "Available."			
	In Ammonia.	Organic, water-soluble.	Organic, water-insoluble.	Found.	Guaranteed.	Water-soluble.	Citrate-soluble.	Citrate-insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.
36	0.07	0.25	1.04	1.72	1.5	4.98	3.04	0.87	8.89	8.0	8.02	7.0	5.61	5.…
36	0.15	0.44	1.84	2.79	2.2	0.13	10.24	6.81	17.18	16.0	10.37	6.5	12.47	12.…
90	0.10	0.16	1.10	2.26	2.0	3.95	3.13	0.95	8.03	7.0	7.08	6.0	10.78	10.…
3	0.03	0.03	0.61	8.80	8.5	0.02	7.24	2.05	9.31	8.0	7.26	4.5	8.56	8.…
5	0.10	0.18	1.04	2.17	2.0	6.82	3.02	1.06	10.90	10.0	9.84	9.0	5.79	5.…
5	0.06	0.39	1.00	2.60	2.5	2.29	5.07	1.33	8.69	8.0	7.36	6.0	9.20	8.…
1	0.14	0.40	2.08	5.03	5.0	1.61	6.84	2.03	10.48	10.0	8.45	7.0	[1]5.78	5.…
34	0.14	0.43	2.27	5.18	5.0	1.22	7.45	2.33	11.00	10.0	8.67	7.0	[2]9.84	10.…
4	0.08	0.73	0.41	1.86	1.6	6.42	3.73	0.72	10.87	10.0	10.15	8.0	2.81	2.…
	....	....	....	1.44	....	0.10	3.57	4.81	8.48	7.5	3.67	....	[3]13.50	14.…
5	0.08	0.36	1.25	2.74	2.3	2.62	5.75	1.65	10.02	10.0	8.37	8.0	5.30	5.…
4	0.10	0.47	1.85	3.66	3.3	1.96	2.68	0.92	5.56	6.0	4.64	4.0	4.73	3.…
1	0.09	0.61	2.01	3.62	3.6	3.20	3.73	0.92	7.85	8.0	6.93	6.0	7.99	7.…
6	0.02	0.22	2.58	2.98	3.0	0.06	11.73	6.56	18.35	16.0	11.79	....	14.22	12.…
73	0.22	0.88	1.49	6.32	6.3	0.45	7.73	1.27	9.45	9.0	8.18	7.0	8.30	7.…
1	0.29	1.00	2.09	4.99	5.0	0.45	6.47	0.72	7.64	8.0	6.92	6.0	[4]11.52	11.…
5	0.26	1.00	1.49	3.70	3.5	0.56	7.86	1.47	9.89	9.0	8.42	7.0	[5]9.60	8.…
0	0.42	1.17	2.48	5.07	5.0	0.09	4.14	0.73	4.96	4.0	4.23	3.0	[6]6.87	5.…
9	0.18	0.74	3.41	5.42	5.0	0.14	4.04	0.27	4.45	4.0	4.18	3.0	[7]5.77	5.…
.	0.95	0.51	1.21	2.67	2.5	2.69	3.55	1.04	7.28	6.5	6.24	6.0	5.08	5.…
.	0.60	0.50	0.66	1.76	1.7	2.37	5.92	1.09	9.38	8.5	8.29	8.0	4.27	4.…
.	0.86	0.34	1.00	2.20	2.1	2.00	4.44	1.16	7.60	6.5	6.44	6.0	2.99	3.…
.	1.30	0.36	1.14	2.80	2.5	2.93	4.87	2.00	9.80	8.0	7.80	8.0	4.50	4.…
.	0.52	0.04	0.52	1.08	0.8	2.10	6.29	1.22	9.61	8.5	8.39	8.0	4.98	5.…

…66% potash as muriate, 4.12% as sulphate. [5] 1.14% potash as muriate, 8.46% as sulph…
…40% potash as muriate, 8.44% as sulphate. [6] 0.74% potash as muriate, 6.13% as sulph…

NITROGENOUS SUPERPHOSPHATES.

Station No.	Manufacturer and Brand.	Place of Sampling.	Dealers' average cash price per ton.	Valuation of the Plant Food in one ton, see
	Sampled by Station Agent: **F. S. Royster Guano Co., Baltimore, Md.** *(Continued.)*			
28*	High Grade Tobacco Manure	Glastonbury, So. Windsor, Broad Brook	$45.50	$30.
20	Ideal Tobacco Guano	No. Granby, So. Windsor, Suffield	35.25	27.
60*	Tobacco Ash Components	Suffield, South Windsor	33.50	20.
26	Universal Truck Fertilizer	Milford, Killingly, No. Haven, Rockville	34.50	25.
	Sanderson Fertilizer and Chemical Co., New Haven, Conn.			
59	Atlantic Coast Bone, Fish and Potash	East Hartford, Guilford, Plainville	26.00	18.
92	Complete Tobacco Grower	Warehouse Pt., So. Windsor	34.00	26.
02	Corn Superphosphate	Shelton, Torrington, East Hampton	28.75	17.
40	Formula A	East Hartford, Shelton, Derby	35.00	25.
99	Formula B	East Hartford, Warehouse Pt. (2)	34.00	25.
65	Kelsey's Bone, Fish and Potash	Branford	27.50	24.
00	Potato Manure	Shelton, Derby, Plainville	30.25	18.
06	Special with 10% Potash	New Haven	37.00	24.
03	Top Dressing for Grass and Grain	New Haven, Warehouse Pt., East Hampton	38.00	29.
	The C. M. Shay Fertilizer Co., Groton, Conn.			
68	Corn Fertilizer	Guilford, Turnerville, Putnam	29.75	20.
69*	Potato Manure	Guilford, Middlefield, Putnam	33.75	26.
45*	Grass Fertilizer	Groton, Turnerville, Killingworth	36.25	27.
	M. L. Shoemaker & Co., Philadelphia, Pa.			
41	"Swift-Sure" Superphosphate for General Use	Hartford, Windsor Locks, Guilford	35.25	27.
08†	"Swift-Sure" Superphosphate for Potatoes	Guilford	35.00	25.
07	"Swift-Sure" Superphosphate for Truck, Corn and Onions	Guilford	29.00	22.

* See note, p. 56. † See note, p. 57.

ANALYSES AND VALUATIONS—*Continued.*

Nitrogen.					Phosphoric Acid.							Potash.	
			Total Nitrogen.					Total.		So-called "Available."			
In Ammonia.	Organic, water-soluble.	Organic, water-insoluble.	Found.	Guaranteed.	Water-soluble.	Citrate-soluble.	Citrate-insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.
2.15	0.38	1.81	4.34	4.9	4.71	2.94	0.32	7.97	5.5	7.65	5.0	[1]8.70	10.0
1.68	0.50	1.90	4.20	4.1	2.86	3.13	0.99	6.98	4.5	5.99	4.0	[2]6.83	6.0
....	....	....	0.44	....	1.34	5.59	0.55	7.48	6.5	6.93	6.0	[3]14.86	15.0
1.69	0.41	1.12	3.22	3.3	3.48	4.74	1.30	9.52	8.5	8.22	8.0	7.26	7.0
0.42	0.34	1.48	2.41	1.7	1.40	4.16	1.98	7.54	6.0	5.56	4.0	4.42	4.0
0.10	0.28	3.80	4.55	4.5	1.13	3.68	0.27	5.08	4.0	4.81	3.0	[4]5.75	5.5
0.16	0.27	1.05	1.86	1.7	4.55	3.97	2.53	11.05	9.0	8.52	7.0	3.02	2.0
0.62	0.30	1.25	3.35	3.3	4.38	3.59	1.84	9.81	9.0	7.97	6.0	6.62	6.0
1.41	0.14	1.65	3.41	3.3	3.63	3.69	2.21	9.53	10.0	7.32	6.0	[5]6.21	6.0
0.70	0.82	1.78	3.30	2.5	1.89	4.72	1.07	7.68	5.0	6.61	4.0	[6]6.13	4.0
0.45	0.28	1.13	2.05	1.7	2.60	3.55	2.06	8.21	8.0	6.15	5.0	6.45	6.0
1.05	0.34	0.50	2.64	2.5	4.55	1.68	0.45	6.68	8.0	6.23	5.0	10.97	10.0
0.53	0.50	1.31	4.40	4.0	4.31	4.26	1.69	10.26	....	8.57	7.0	7.32	7.0
0.07	0.86	1.95	2.88	2.5	4.64	3.02	0.59	8.25	....	7.66	7.0	3.80	3.0
0.12	0.97	1.96	3.98	3.5	3.53	4.39	0.96	8.88	....	7.92	7.5	5.77	6.0
0.10	1.21	2.08	4.12	4.0	2.93	4.21	1.05	8.19	....	7.14	7.5	6.27	6.0
0.02	0.70	1.19	3.08	2.9	8.60	2.81	0.91	12.32	....	11.41	9.0	[7]5.41	4.5
0.02	0.68	0.87	2.67	2.9	7.00	4.06	1.87	12.93	....	11.06	8.0	7.07	7.0
0.00	0.45	0.95	2.24	1.7	6.73	3.50	1.78	12.01	....	10.23	8.0	5.34	5.0

9% potash as muriate, 6.71% as sulphate.
0% potash as muriate, 5.83% as sulphate.
26% potash as muriate, 0.60% as sulphate.
4% potash as muriate, 4.81% as sulphate.
[5] 0.90% potash as muriate, 5.31% as sulpha
[6] 1.40% potash as muriate, 4.73% as sulpha
[7] 0.40% potash as muriate, 5.01% as sulpha

Nitrogenous Superphosphates.

Manufacturer and Brand.	Place of Sampling.	Dealers' average cash price per ton.	Valuation of the Plant Food in one ton, see p. 3.	Percentage difference
Sampled by Station Agent:				
Swift's Lowell Fertilizer Co., Boston, Mass.				
Animal Brand	Windsor Locks, Suffield, Wallingford, Southington	$32.75	$19.73	6
Bone Fertilizer	Windsor Locks, Rockville, Guilford	30.00	17.48	[illegible]
Corn and Vegetable Manure	*Wallingford*, New Canaan, Torrington	38.00	25.32	5
Empress Brand	Southington, New Britain, Moosup	27.75	12.95	11
Perfect Tobacco Grower	Rockville, Ellington, Warehouse Pt.	38.25	25.77	4
Market Garden Manure	Rocky Hill, So. Manchester	39.00	26.48	4
Potato Grower	Southport, Wallingford, Guilford	35.00	26.05	3
Potato Manure	Windsor Locks, Southington, Rockville	31.75	16.35	9
Potato Phosphate	New Britain, Suffield, Southport	34.00	21.16	6
Special Grass Mixture	New Britain, Rockville, Ellington	39.00	27.16	4
Special Potato Fertilizer	New Britain, Torrington, Saybrook	36.75	23.29	5
Superior Fertilizer	*Wallingford, Rockville*, Wethersfield	37.75	27.85	3
Tobacco Manure	New Hartford	43.00	32.10	3
Tanner & Wilcox, Winsted, Conn.				
Grass and Corn Phosphate	Winsted	37.00	31.32	1
Reliable Potato and Garden Phosphate	Winsted	34.00	29.00	1
The Wilcox Fertilizer Co., Mystic, Conn.				
Complete Bone Superphosphate	Wallingford	29.00	19.62	4
Corn Special	Ellington, Westchester	32.50	22.72	4
Fish and Potash	Norwich, Wallingford, East Hampton	27.00	20.05	3
4-8-10 Fertilizer	Mystic	40.50	29.38	3
Grass Fertilizer	Mystic	37.50	25.85	4
H. G. Fish and Potash	*Ellington*	31.00	24.44	2
H. G. Tobacco Special	Ellington	38.00	27.29	3
Potato Fertilizer	Norwich, East Hampton, Thompsonville	32.25	20.13	6

* See note, p. 57.

ANALYSES AND VALUATIONS—*Continued.*

Nitrogen.					Phosphoric Acid.							Potash.	
			Total Nitrogen.					Total.		So-called "Available."			
In Ammonia.	Organic, water-soluble	Organic, water-insoluble.	Found.	Guaranteed.	Water-soluble.	Citrate-soluble.	Citrate-insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.
0.42	0.78	0.80	2.41	2.5	5.99	2.26	0.67	8.92	9.0	8.25	8.0	4.14	4.0
0.26	0.72	0.55	1.79	1.6	6.20	2.81	1.10	10.11	9.0	9.01	8.0	3.13	3.0
0.05	0.75	0.98	3.28	3.3	6.37	1.82	0.50	8.69	9.0	8.19	8.0	7.34	7.0
0.03	0.62	0.54	1.34	1.3	4.44	2.53	0.51	7.48	8.0	6.97	7.0	2.02	2.0
0.06	0.46	1.05	3.95	4.1	2.72	3.50	0.69	6.91	5.0	6.22	4.0	[1]6.39	6.0
0.10	1.05	1.30	3.88	4.1	5.69	2.15	0.81	8.65	8.0	7.84	7.0	6.28	6.0
0.09	0.58	1.63	3.16	3.3	4.52	1.94	0.51	6.97	7.0	6.46	6.0	10.22	10.0
0.36	0.43	0.70	1.61	1.6	5.19	2.69	0.81	8.69	8.0	7.88	7.0	3.92	4.0
0.08	0.46	0.88	2.50	2.5	6.51	1.79	0.49	8.79	9.0	8.30	8.0	5.60	6.0
0.08	1.10	1.26	3.98	4.1	5.56	2.35	0.65	8.56	8.0	7.91	7.0	6.72	6.0
0.65	0.75	0.90	2.60	2.5	4.17	2.28	0.50	6.95	7.0	6.45	6.0	9.54	10.0
0.51	0.80	0.95	3.53	3.7	5.60	1.95	0.42	7.97	8.0	7.55	7.0	10.07	10.0
0.10	0.92	1.35	4.02	4.0	3.15	5.14	1.47	9.76	7.0	8.29	5.0	[2]10.06	10.0
0.12	0.43	1.75	4.76	4.0	1.84	6.38	3.28	11.50	11.0	8.22	....	7.56	7.3
0.10	0.84	1.92	3.91	3.3	0.75	6.21	3.39	10.35	9.3	6.96	8.0	9.06	9.0
0.12	0.21	1.21	2.23	2.1	2.99	5.53	3.28	11.80	9.0	8.52	8.0	3.67	3.0
0.10	0.25	1.50	2.68	2.5	5.14	3.69	1.74	10.57	9.0	8.83	8.0	5.55	5.0
0.28	0.62	2.05	2.95	2.5	2.12	3.88	1.80	7.80	6.0	6.00	5.0	3.82	3.0
1.10	0.21	0.95	3.40	3.3	7.20	1.37	0.68	9.25	9.0	8.57	8.0	[3]10.79	10.0
0.92	0.17	1.47	4.00	4.1	4.07	3.20	2.07	9.34	7.0	7.27	6.0	5.62	5.0
0.26	0.62	2.79	3.67	3.3	4.80	1.99	0.51	7.30	7.0	6.79	6.0	5.31	5.0
0.08	0.22	2.25	3.72	3.3	0.10	5.99	4.45	10.54	7.0	6.09	5.0	[4]6.93	7.0
0.12	0.25	1.32	2.32	2.1	2.00	5.02	3.10	10.12	7.0	7.02	6.0	5.44	4.5

% potash as muriate, 5.09% as sulphate. [3] 7.97% potash as muriate, 2.82% as sulphate
% potash as muriate, 7.06% as sulphate. [4] 0.80% potash as muriate, 6.13% as sulphate

NITROGENOUS SUPERPHOSPHATES.

Manufacturer and Brand.	Place of Sampling.	Dealers' average cash price per ton.	Valuation of the Plant Food in one ton, see p. 3.
Sampled by Station Agent: **The Wilcox Fertilizer Co., Mystic, Conn.** *(Continued.)*			
Potato, Onion and Vegetable Phosphate	Norwich	$36.00	$27.72
Special Superphosphate	Westchester	26.00	15.82
S. D. Woodruff & Sons, Orange, Conn.			
Home Mixture*	Orange	31.00	....
Sampled by Purchasers and others:			
Berkshire Tobacco Special with Carbonate Potash	*Thompsonville:* James Gamble	36.00	29.00
Bowker's Tobacco Ash Elements	*Suffield:* Bissell-Graves Co.	32.50	22.24
Rogers' H. G. Fertilizer for Oats and Top Dressing	*Granby:* J. B. Cannon	44.50	37.61
Rogers' Soluble Tobacco Manure	*Granby:* J. B. Cannon	43.50	35.20
Sanderson's Grass and Grain	*Shelton:* O. G. Beard	38.00	25.31
Shay's Potato Fertilizer	*Colchester:* H. London	31.00	26.99
Shay's Corn Fertilizer	*Colchester:* H. London	26.00	21.08
Shay's Special	*Manchester:* C. R. Burr & Co.	40.00	35.80

* See *note*, p. 57.

VALUATION.

The method and meaning of valuation is explained on pages 3 to 7 and the table of trade values will be found on page 6.

It must be remembered that "valuation" as used in this report ***is not a valuation of the brand in question but of the nitrogen, phosphoric acid and potash in it;*** that is, it shows approximately what the same amounts of these ingredients as are contained in a ton of the mixed fertilizer would cost, unmixed, for cash, at freight centers in this State, in their unground and unmixed condition. To make a fair valuation of the manufactured fertilizer itself would necessitate adding to our valuation the

ANALYSES AND VALUATIONS—*Concluded.*

Nitrogen.					Phosphoric Acid.							Potash.	
			Total Nitrogen.					Total.		So-called "Available."			
In Ammonia.	Organic, water-soluble.	Organic, water-insoluble.	Found.	Guaranteed.	Water-soluble.	Citrate-soluble.	Citrate-insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.
0.14	0.22	1.98	3.50	3.3	7.05	2.35	0.45	9.85	9.0	9.40	8.0	[1]7.64	7.0
0.12	0.19	1.08	1.48	1.0	1.95	6.22	3.52	11.69	9.0	8.17	8.0	2.52	2.0
0.08	0.27	1.66	3.73	3.3	4.01	2.84	1.36	8.21	8.0	6.85	....	8.27	8.0
0.05	4.16		4.82	4.5	0.18	3.23	0.27	3.68	4.0	3.41	3.0	[2]5.73	5.5
....	....	....	....	....	1.10	5.99	1.57	8.66	9.0	7.09	6.0	[3]15.30	15.0
0.25	2.31		6.22	6.3	1.62	6.72	1.19	9.53	9.0	8.34	7.0	10.15	7.5
0.34	3.03		5.12	5.0	0.39	6.61	0.88	7.88	7.0	7.00	5.0	[4]10.50	10.5
0.10	0.40	0.71	3.52	4.0	5.47	3.15	0.50	9.12	....	8.62	7.0	6.47	7.0
0.16	1.09	1.83	4.06	3.5	3.14	4.63	0.93	8.70	8.0	7.77	7.5	6.15	6.0
0.10	0.78	1.88	2.90	....	4.78	3.28	0.63	8.69	....	8.06	....	3.54	....
0.14	1.97	2.16	5.91	5.8	0.36	5.10	0.99	6.45	8.0	5.46	....	11.10	10.0

8% potash as muriate, 0.86% as sulphate. [3] 1.20% potash as muriate, 14.10% as sulpha
0% potash as muriate, 0.85% as sulphate, [4] 1.16% potash as muriate, 9.34% as sulpha
4.18% as carbonate.

average cost of mixing and bagging, bags, shrinkage, cost of storage, selling, collecting, freight, etc., items which would probably aggregate $8.00 to $12.00 per ton.

PERCENTAGE DIFFERENCE

shows the percentage excess of the cost price over the average cost at freight centers of the nitrogen, phosphoric acid and potash contained in the fertilizer: that is, the percentage amount which is added to the cost of the raw materials as the cost of manufacture and sale.

Nitrogenous Superphosphates Sampled by Purchasers.

Here are included eight analyses of samples sent by individuals. The Station is not responsible for the accuracy of the sampling.

HOME MIXTURES.

In the table, page 86, are given analyses of sixteen fertilizers and the formulas by which they were mixed, as stated by their owners. Two of the mixtures were made in factories, the others were made on the farm.

Obviously, there is a mistake in the formula given or in the mixing of **642**, not mixed by the purchaser, for a mixture with 333 pounds of muriate of potash in the ton would contain at least 8.0 per cent. of potash, while this sample has only 0.49. The same thing is true of **593**. Four hundred pounds of double sulphate of potash in the ton should give at least 5.0 per cent. of potash instead of 1.58 per cent.

In the other cases the actual analysis agrees fairly with the analysis as calculated from the formula.

With few exceptions, these fertilizers are of high grade; i. e., they contain relatively high percentages of nitrogen, phosphoric acid and potash.

The average percentage composition of the whole number is

Nitrogen as nitrates	2.13
Organic nitrogen	2.10
Total nitrogen	4.23
"Available" phosphoric acid	8.13
Potash	7.82

As to the cost of plant food in these home-mixtures the facts are:

In less than car-lots, delivered, one person bought the chemicals and made two mixtures, of which the average cost *for chemicals alone* was $32.75 and the valuation $33.69.

In car-lots, delivered, one person made two mixtures, of which the average cost and valuation *for chemicals alone* were $24.76 and $29.01 respectively.

Another made five mixtures, for which the average cost and valuation were $27.72 and $27.71 respectively.

Two other individuals bought (whether in car-lots or in smaller quantities is not stated) for $28.29 and $36.42 respectively and the valuations were $28.94 and $30.28 respectively.

Another bought two mixtures made on his formula at factories, of which the average cost was $39.27 and valuation $36.49.

C. I. Stone reports the actual cost to him of mixing and bagging a ton of fertilizer as seventy-eight cents. This probably does not include cost of bags as the bags holding the chemicals could be used for the mixture. Allowing an average of $1.50 per ton for mixing and bagging, those who bought their raw materials in mixed car-lots for cash got the mixture at a price which was quite close to the valuation of the ingredients, and in no case more than $2.50 above the valuation. The same is true in several other cases.

Most of the samples were quite fine and dry enough to spread with a drill or fertilizer sower. None were coarser than some of the factory mixtures.

It is quite clear that men with good business sense, who can buy their fertilizer chemicals for cash, in mixed car-lots and mix them before the season opens, can usually save money by doing it.

Those farmers who buy only a small amount of fertilizer, or who are not prepared to make cash payment, or to determine some time in advance what kind of plant food they need and how much, are not likely to make a success of home-mixing.

With a system of coöperative buying and better rural banking facilities, more farmers could profitably buy chemicals and mix for themselves.

In comparing the cost of home-mixed with factory-mixed fertilizers, it must be remembered that the ruling prices of the latter necessarily cover, not only the fair price of the mixtures, but also a charge for doing the banking business of the purchasers. For example, in the majority of cases, the fertilizer manufacturer who sells a ton of fertilizer for $33, waits several months, often nine to twelve months, for his pay. That $33.00, or the larger part of it, he has borrowed at his bank, paying perhaps five per cent. interest, giving security to the bank and meeting his note the day it is due. So to the price which would yield him a fair profit if the goods were sold for cash he is compelled to add an amount which will fully cover the interest he is forced to pay and the occasional failures of buyers to pay within the time agreed upon. He who buys on time forces the seller to do two separate kinds of business for him, make his fertilizer and be his banker.

Home Mixtures—Formulas.

Station No.	Made by or for	Formula. Nitrate of Soda.	Dried Blood.	Ground Bone.	Tankage.	Dried Fish.	Blood, Bone and Meat.	Guano.	Acid Phosphate.	Muriate of Potash.	Sulphate of Potash.	Double Manure Salt.
50	E. J. Ayres, North Franklin, No. 1 for Grass	400	...	500	350	...	....	.....	400	350	...	....
61	E. J. Ayres, North Franklin, No. 2 for Potatoes	200	...	600	400	...	....	.....	400	400	...	....
08	H. E. Clark, Middlebury, Grass Mixture	400	300	900	....	...	....	.....	.....	....	400	....
06	Conn. School for Boys, Meriden, Grass	500	...	....	500	...	....	.....	400	[4]250	...	....
07	Conn. School for Boys, Meriden, Vegetable	100	...	....	750	...	....	.....	750	200	200	....
12	H. W. Ferry, So. Glastonbury	333	...	....	....	...	....	333	1000	333	...	....
54	Gaylord Farm, Wallingford, Garden	200	100	....	....	600	....	.....	850	....	250	....
55	Gaylord Farm, Wallingford, Orchard	200	...	....	....	...	600	.....	[3]500	....	...	20
53	Gaylord Farm, Wallingford, Orchard and Corn	...	...	....	....	...	1000	.....	500	....	...	50
56	Gaylord Farm, Wallingford, Potatoes	250	300	....	....	300	....	.....	750	....	...	40
81	Wilber Hills, Wapping	300	...	....	1300	...	....	.....	.....	400	...	....
93	A. E. Phelps, Glastonbury	...	...	[2]400	....	...	....	[1]1200	.....	....	400	....
46	C. I. Stone, Marion, Grass	534	...	....	....	...	....	.....	1180	286	...	....
17	W. M. Whitcomb, W. Cheshire	500	...	200	....	...	....	.....	900	400	...	....
51	W. L. Merwin, Milford	...	...	....	....	600	....	.....	400	....	...	[5]100
52	C. Z. Murdock, Meriden	500	...	[2]500	500	...	....	.....	.....	500	...	....

[1] Cotton seed meal. [2] Precipitated bone. [3] And 500 lbs. basic slag. [4] And 350 lbs. kainit. [5] Kainit.

VI. MISCELLANEOUS FERTILIZERS.

LIMESTONE.

Here are included the nearly pure lime carbonate and also the double carbonate of lime and magnesia known as dolomite. From both of these, "burned lime" or "quick lime" is prepared, both for building purposes and also (particularly when its color is poor or it has been imperfectly burned) for agricultural use. The following analyses of ground and unground limestone show its usual composition.

HOME MIXTURES—ANALYSES.

[Stat]ion No.	Nitrogen. In Nitrates.	In Ammonia.	In Water-soluble organic.	In Water-insoluble organic.	Total.	Phosphoric Acid. Water-soluble.	Citrate-soluble.	Citrate-insoluble.	Total.	Potash.	Cost per ton.
460	3.06	0.05	0.19	1.66	4.96	2.41	5.93	2.61	10.95	11.83	[8]$33.
461	1.46	0.05	0.54	1.60	3.65	2.82	7.53	3.25	13.60	10.69	[8]32.
508	2.92	0.20	0.98	1.14	5.24	0.07	9.23	4.75	14.05	[1]8.91	[9]37.
306	3.52	0.07	0.72	1.03	5.34	1.35	3.99	1.11	6.45	9.08	[10]26.
307	0.83	0.07	0.88	1.53	3.31	3.49	4.97	2.11	10.57	[2]7.93	[10]22.
542	3.08	0.13	0.08	0.15	3.44	5.88	5.39	1.73	13.00	0.49	35.
464	1.59	0.19	0.37	2.31	4.46	3.12	4.06	1.70	8.88	[3]7.30	[10]31.
465	1.48	0.06	0.77	1.15	3.46	1.18	6.34	3.62	11.14	[4]3.58	[10]24.
463	0.18	0.11	0.22	2.78	3.29	2.24	4.17	1.94	8.35	[5]8.07	[10]26.
466	1.99	0.12	0.55	1.74	4.40	4.41	2.46	1.14	8.01	[6]6.24	[10]29.
481	2.33	0.02	2.60		4.95	0.26	10.93	2.26	13.45	10.08	[9]41.
593	0.23	0.10	0.06	3.85	4.24	0.86	6.01	0.50	7.37	[7]1.58	......
546	4.06	0.00	0.12	0.02	4.20	7.41	1.67	0.67	9.75	7.92	[11]28.
517	3.70	0.03	0.38		4.11	4.86	3.89	0.96	9.71	10.20	[11]36.
561	......	0.19	0.24	2.16	2.59	1.30	2.94	1.38	5.62	7.73	25.
562	3.60	0.08	0.54	1.85	6.07	1.11	9.04	0.15	10.30	13.56	.....

[1] 0.80% as muriate, 8.11% as sulphate.
[2] 7.31% as muriate, 0.62% as sulphate.
[3] 0.97% as muriate, 6.33% as sulphate.
[4] 0.90% as muriate, 2.68% as sulphate.
[5] *1.59% as muriate, 6.48% as sulphate.*
[6] *1.22% as muriate, 5.02% as sulphate.*
[7] 0.60% as muriate, 0.98% as sulphate.
[8] Less than car lots unmixed delivered.
[9] Delivered mixed.
[10] Car lots unmixed delivered.
[11] Home mixed delivered.

682. Sent by W. F. Tomlinson, F. D., of Danbury.

680 and **681.** Sent by W. H. Seeley, Boston,

615 and **616.** Sent by W. T. Coe & Son, Northford.

630. Sent by E. B. Clark Seed Co., Milford.

358. Sold by the Stearns Lime Co., Danbury. Sent by F. Howard Ensign, East Hartford.

140. Sent by J. F. Merrell, Suffield.

438. Sent by Plumtree Lime Co., Danbury.

ANALYSES OF LIMESTONE.

tation No.	682	680	615	681	630	358	616	140
.ime	55.80	55.20	54.04	52.26	48.96	44.01	42.70	33.36
ſagnesia	0.18	0.30	0.54	1.91	1.22	1.21	1.60	19.24
:quivalent Carbonate of Lime	99.64	98.57	96.50	93.32	87.43	78.60	76.25	59.57
'arbonate of Magnesia	0.36	0.63	1.13	4.01	2.56	2.54	3.36	40.40
ther matters by difference*	.00	0.80	2.37	2.67	10.01	18.86	20.39	0.03
	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

Chemically pure limestone contains 56 per cent. of lime (the oxide of a metal calcium which does not occur in nature and is of no use in the arts) and 44 per cent. of carbonic acid. **682** and **680** are very nearly pure. **615** and **681** are nearly pure but contain over 2 per cent. of other and insoluble minerals. **630**, **358**, and **616** contain very considerable amounts of other minerals which are associated in nature with the carbonate and cannot be removed. **140** and **438** are dolomites, or magnesian limestones containing about 20 per cent. of magnesia replacing lime.

The Stearns Lime Co. of Danbury sell two grades of ground limestone, "Ten mesh" and "Forty mesh." These terms signify sieves with ten meshes or forty meshes to the linear inch. Fineness of product will of course depend on the thickness of the wire of which the sieve is made. Samples of the two grades, kindly sent by the company, have been screened through standard sieves with the following results:

	Ten Mesh Limestone.	Forty Mesh Limestone.
Coarser than 20 mesh	14	0
Between 20 and 30 mesh	17	11
" 30 " 40 "	8	9
" 40 " 50 "	3	6
" 50 " 80 "	10	15
" 80 " 200 "	14	18
Finer than 200 mesh	34	41
	100	100

* Chiefly matter insoluble in acid.

BURNED OR QUICK LIME.

A single sample, **139**, made by the Lee Lime Co., Lee, Mass., sampled and sent by J. F. Merrell, Suffield, cost $4.00, in car lots at the kiln. It contained

Lime	51.48
Magnesia	36.34
Insoluble matter	3.33
Free and combined water	8.85
	100.00

This is made from magnesian limestone by roasting in a kiln which drives off the carbonic acid as a gas and leaves lime and magnesia (calcium and magnesium oxides).

If we allow $2.00 for freight, lime and magnesia together cost, delivered, about 34 cents per 100 pounds in car lots.

SLAKED LIME.

Burned lime like the sample described has a great avidity for water and absorbs it rapidly from the air or if sprinkled with water combines with it quickly, developing great heat. There is formed slaked lime which is a hydrate and contains when pure about 75.7 per cent. of lime. Burned lime also combines with carbonic acid again to form carbonate of lime, with only 56 per cent. of lime.

The slaked limes of commerce are mixtures of hydrate and carbonate. The following analyses show the usual range of composition.

3. Sold by the Farnams Lime Co., Farnams, Mass. Sent by J. W. Alsop, Avon.

617. *Air-slaked. Sent by* W. T. Coe & Son, Northford.

182. Agricultural Lime from Farnams-Cheshire Lime Co. Sent by B. W. Rothe, Rockville.

638. Patent Process Fertilizer Lime. Sold by Walton Quarries, Harrisburg, Pa. Stock of John Hesser, Killingworth.

131. Agricultural Lime from Farnams Lime Co. Sent by F. E. Peckham, Norwich.

4. Agricultural Lime from Farnams Lime Co. Sent by H. K. Brainard, Thompsonville.

ANALYSES OF SLAKED LIME.

Station No.	3	617	182	638	131	4
Lime	65.64	65.20	62.88	61.32	60.56	60.14
Magnesia	0.82	0.86	1.59	6.64	0.93	1.06
Insoluble in acid	.....	1.81	1.66	4.21	1.65	.....
Cost per ton, ...	$3.50*	.....	4.00*	18.00	5.85	8.50
Lime-magnesia costs cents per 100 lbs. ...	.40†	.....	.46†	1.33	.47	.69

Samples **3**, **182**, **131**, were bought at about the ruling rates. Anything over $6.00 per ton for slaked lime, delivered, is not economical. Special attention is called to the "patent process" lime. This is a fine slaked lime, no better for agricultural use than the other samples. It has, however, been sold to a number of farmers in this state for $18.00 per ton, or just about three times as much as need be paid for lime which is quite as valuable agriculturally.

SHELL MARL LAND LIME.

215. Sold by the Vermont Marl Co., Brattleboro, Vt. Sampled and sent by Jared Bishop, Cheshire.

It contained 51.62 per cent. of lime and 0.51 per cent. of magnesia, both chiefly in form of carbonate.

WOOD ASHES AND WOOD ASHES SUBSTITUTES.

578. Bowker's Wood Ashes, from Bowker Fertilizer Co. Stock of Lightbourn and Pond, New Haven.

524. Canada Ashes from John Joynt, Lucknow, Ont. Stock of H. G. Church, South Windsor.

683. Hardwood Ashes, sold by W. L. Mitchell, Houlton, Me. Sent by Keiser and Boasberg Plantation, Inc., East Windsor Hill.

529. Wood Ashes, sold by Olds & Whipple, Hartford. Stock of W. C. George, Warehouse Point.

927. Unleached Wood Ashes imported by Geo. L. Munroe & Sons, Oswego, N. Y. Guaranty, 1 per cent. potash, 0.50 phosphoric acid, 25.0 per cent. lime. Sampled and sent by F. W. Judson, Watertown.

570. Lime and Ashes. Sent by W. A. Reed, Meriden.

* At kiln. † Adding $1.85 freight.

214. Wood Ashes Substitute, sold by the Vermont Marl Co., Brattleboro, Vt. Sample sent by John Bishop, Storrs.

26. Ashes from a Meriden factory. Sampled and sent by W. H. Lyon, Meriden.

The collection is a typical one. The cost given for **578** is probably what is charged for small amounts for lawns, etc.; the other prices are for car lots.

One lot of hardwood ashes, **683**, has about the composition which clean, dry, hardwood ashes should have. Allowing 4 cents per pound for phosphoric acid and 4¼ for potash, the lime and magnesia in these ashes costs 45 cents per 100 lbs., which is not excessive.

Of the other four samples of "wood ashes," more than one-third of one and more than one-half of two others consists of water, sand, coal and other useless ballast.

ANALYSES OF WOOD ASHES, ASHES SUBSTITUTES, ETC.

Station No.	578	524	683	529	927	570	214	26
Percentage amounts of								
Water-soluble potash	2.91	1.35	6.92	2.40	3.00	0.18	5.66	0.21
Phosphoric acid	1.30	0.87	2.78	0.95	1.24	0.19	1.59	0.32
Lime	26.04	24.77	34.15	16.48	31.54	38.86	42.03	3.99
Magnesia	2.60	1.41	3.27	2.18	....	0.74	0.85	0.82
Water	6.76	37.82	2.62	13.55	....	1.66	1.10	9.05
Charcoal	27.82	10.03	13.00	40.09	12.37	25.49	6.35	80.35
Insoluble in acid								2.32
Cost per ton	$18.00*	13.75	11.50	11.75	11.00	....	15.00	....

The cost of lime and magnesia, calculated as above, is in **524**, $1.56, in **529**, $2.89, and in the wood ashes substitute, **214**, $1.04, per 100 pounds. Lime and magnesia can readily be bought in ground limestone, pulverized burned lime or slaked lime for 50 cents per 100 pounds, or less.

HEN MANURE.

129. Sent by E. L. Ford, Jr., Milford, represents material gathered each week from the hen houses and stored in a bin under cover.

It contained water 51.7, nitrogen 2.88, phosphoric acid 1.15, and potash 1.18 per cent.

* Retail in small lots for lawns.

SHEEP MANURE.

619. Pulverized Sheep Manure, sold by American Agric. Chem. Co., New York City; sampled from stock of Greenwich Hardware Co., Greenwich.

373. Sheep's Head Brand Pulverized Sheep Manure, sold by Natural Guano Co., Aurora, Ill.; sampled from stock of F. S. Platt Co., New Haven.

374. Sheepino Natural Guano, sold by Niantic Menhaden Oil and Guano Co., South Lyme; sampled from stock of J. P. Barstow and Co., Norwich.

377. Wizard Brand Manure, sold by Pulverized Manure Co., Chicago; sampled from stock of F. S. Platt Co., New Haven.

	619	373	374	377
Nitrogen in nitrates			0.42	
" " ammonia	0.17	0.20	0.10	0.45
" organic, water-soluble	0.54	0.37	0.06	0.27
" " active insoluble	0.59	0.42	0.28	0.36
" " inactive insoluble	1.35	1.56	0.76	1.32
Total nitrogen found	2.65	2.55	1.62	2.40
" " guaranteed	2.06	2.25	1.50	1.80
Water-soluble phosphoric acid	0.86	1.02	0.23	0.99
Citrate-soluble " "	0.12	0.05	0.91	0.37
Citrate-insoluble " "	0.18	0.18	0.28	0.12
Total phosphoric acid found	1.16	1.25	1.42	1.48
" " " guaranteed	0.50	1.50	1.00	4.00
Potash found	1.82	1.88	4.26	1.85
" guaranteed	0.50	1.50	4.00	1.00
Cost per ton	$30.00	30.00	38.00	30.00

377. Wizard Brand contains much less phosphoric acid than is guaranteed. The percentage of potash in **374,** Sheepino Natural Guano, is much higher than is ordinarily found in dry sheep manure.

TOBACCO SIFTINGS.

No. **9** received from H. K. Brainard, Thompsonville, contained the following percentages:

Nitrogen of nitrates 0.25, of ammonia 0.24, nitrogen organic 171. Total nitrogen 2.20, phosphoric acid 0.64, potash 2.63.

Tobacco stems, with which this may be compared, contains on the average,

Total Nitrogen	2.05
Phosphoric Acid	0.60
Potash	7.54

"CLAY DEPOSIT."

70. Sent by Geo. H. Pearson, Bethel. A deposit in a vein several feet deep in the bed of a stream.

It is a fine silt, but contains no clay nor diatoms. Apparently it is largely an iron and alumina silicate.

Insoluble in acid	56.35
Oxide of iron and alumina	22.88
Lime	4.50
Magnesia	2.45
Water at 100°	9.28
Undetermined	4.54
	100.00

PART II.

Seventeenth Report on Food Products and Fifth Report on Drug Products, 1912.

By John Phillips Street.*

This station is required by law to make examinations of food and drug products, to publish its findings, and to report to the dairy and food commissioner all cases of adulteration or misbranding which are discovered. Under this law a large number of samples of food and drugs have been bought in various parts of the state and carefully examined, and cases of adulteration or misbranding reported to the commissioner. The station has no power of prosecution, its duty being to determine the facts and supply expert testimony in case of prosecution.

Of the 496 samples collected by the station agent, 253 were passed, and 92 were adulterated, below standard or misbranded. Eighty-five of these 92 were reported to the commissioner, and 45 second samples of these brands were bought by his agents of the same dealers, and sent to the station for analysis. Of these 28 were adulterated or misbranded. The dairy and food commissioner has also sent 712 samples, chiefly milk, molasses, sausage, butter and turpentine. These will be briefly discussed, leaving the full details and the results of prosecution to be given in the commissioner's report. Of these samples 344 were adulterated, misbranded, or below standard. To summarize: Of 757 samples taken by the commissioner under the law, 372 were found to be either adulterated, misbranded or below standard. The station has been called on for court testimony in seventeen instances. Besides the above, 288 samples were examined for the commissioner in connection

* The analytical work herein reported was done jointly with E. M. Bailey, C. B. Morison, R. B. Roe and C. E. Shepard.

with a study of net weight and volume of package goods and a number of samples of food and drug products have been examined for individuals, which will likewise receive brief mention.

I. FOOD PRODUCTS.

CANNED CORN.

The present examination was undertaken primarily to study completeness of fill and net weight of contents in connection with the net weight and measure law recently enacted in this state. The chemical work was limited to a determination of dry matter and testing for presence of saccharin.

The average composition of 42 samples of canned corn analyzed by McElroy & Bigelow* was as follows:

Water	75.50
Ether Extract	1.28
Crude Fiber	.80
Ash (–NaCl)	.47
Sodium Chloride	.36
Protein	2.84
Carbohydrates	18.75

Fresh sweet corn contains about 73 per cent. of water. The only ingredients generally added in canning are about 5 per cent. of water, and small quantities of salt and sugar. A properly filled No. 2 can of corn should contain about 21 ozs. of material. Disregarding the small amounts of added salt and sugar and assuming that 5 per cent. of water has been added, the can should contain about 473 gms. of water and 122 gms. of dry matter, or 79.5 and 20.5 per cent., respectively. As the addition of salt and sugar would reduce the percentage of water content, it is apparent that under the usual methods of canning a No. 2 can of corn should not contain more than 473 gms., or 79.5 per cent. of water; in fact with the best methods of practice the amount of water would undoubtedly be less.

With one exception, No. **27898**, the net weight of all of the 36 samples here reported varied within quite narrow limits from 571 to 614 gms., average 594 gms. Thirty-one contained 581

* U. S. Dept. Agl., Bur. of Chem., Bull. 13, pt. 8, 1126.

gms. or over, that is, within 0.5 ozs. of the standard fill of 21 ozs. The weight and percentage of water found in the samples may be summarized as follows:

No. of Samples.	Gms. Water.	No.	Per Cent. Water.
5	446-455	4	75.2-76.6
9	456-465	9	76.8-78.3
10	466-473	11	78.5-79.5
9	474-480	6	79.6-80.8
3	481-496	6	81.0-83.0

Twelve of these samples, therefore, probably contain an excessive amount of water. They contain from 95 to 122 gms. of dry matter per can, average, 112 gms., as compared with from 121 to 149, average, 133 gms., in the other twenty-four samples.

According to Bitting* the can should be filled within 3/8 in. of the top. In our samples the air space was 3/8 in. in 12, 1/2 in. in 17, 5/8 in. in 6, and 3/4 in. in 1. In seven samples, therefore, there was a tendency towards short fill, but inasmuch as in these samples the net weights of contents were 614, 591, 585, 593, 579, 577 and 592 gms., the deficiency was more apparent than real, and is probably largely due to slight variations in the dimensions of the cans rather than to any shortage of corn.

Six of the cans showed no corrosion, eleven traces, thirteen slight, five considerable and one much.

No saccharin was found in any of the samples.

The retail cost of the corn ranged from 7 to 16 cents per can, average 12 cents. Of course price depends to a considerable extent on quality, a matter not specially studied in this report.

DRIED FRUITS.

The examination of the one hundred and two samples of dried fruits was undertaken primarily to study the variations in weight of dried fruits sold in package form, and the losses in weight after keeping for several months. The results of these studies are given in Bulletin 172 of this station. Incidentally some chemical data were secured which are here published together with a full description of the samples. The changes in weight shown during storage are given in detail, but the discussion in the bulletin referred to above will not be repeated.

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* Bur. of Chem., Bull. *151*, 50.

TABLE I.—

Station No.	Manufacturer, or Jobber, and Brand.
27649	Austin, Nichols & Co., New York. Extra Quality Cream Brand Sugar
27822	The Baxter Bros. Co., Brunswick, Me. Sterling Brand Standard Grade Sugar
27622	A. F. Beckmann & Co., New York. Gold Rock Brand Sweet Tender
27644	The Burt Only Canning Co., Oneida, N. Y. Holiday Brand Sweet
27906	" " " " Nectar Brand Sweet
27821	" " " " Rose of Sharon Brand Sweet
27949	*The F. C. Bushnell Co., New Haven. Northern Queen Brand Sweet Sugar*
27611	*Lewis DeGroff & Son, New York. Health Brand Sweet*
27693	The Fame Canning Co., Tipton, Ind. Fame Brand Sugar
27961	The R. N. Fitz Gerald Co., Hartford. Mascot Brand Fancy Maine
27674	Henry L. Forhan, Portland, Me. Forhan's Square Brand Fancy Maine Sugar
27793	Henry L. Forhan, Portland, Me. Forhan's Square Brand Fancy Maine Sugar
27966	Henry L. Forhan, Portland, Me. Lake Brand Maine Sugar
27806	" " " Sundrop Brand Sugar
27943	Fort Stanwix Canning Co., Rome, N. Y. Flag Brand Sweet Kernel Finest Quality
27800	The Wm. M. Geer Co., New York. Half Moon Brand Fancy
27619	Great Atl. & Pacific Tea Co., Jersey City, N. J. Iona Brand
27916	Francis H. Leggett & Co., New York. Premier Brand
27898	Miner, Read & Tullock, New Haven. Sphinx Brand Sugar
27995	*R. H. Nesbit Co., New Haven. Fancy Maine Sugar*
27996	Oswego Preserving Co., Oswego, N. Y. Magnet Brand Sweet Standard *Quality*
27925	Oswego Preserving Co., Oswego, N. Y. Silver Key Brand Standard *Quality* Sugar
27923	Portland Packing Co., Portland, Me.. Red Top Brand Maine Finest Sugar First Quality
27666	Preston Canning Co., Preston, Md. Crown of Maryland Brand Sugar
27903	Thos. Roberts & Co., Philadelphia. Northern Queen Brand Sweet Sugar
27945	Saco Valley Canning Co., Portland, Me. Fairfield Brand Sugar
27612	" " " Falmouth Brand Sugar
27610	Seeman Bros., New York. White Rose Baby Brand
27692	R. F. Smith, Norwich. Shetucket Brand Sugar
27924	Sprague, Warner & Co., Chicago. Richelieu Brand
27893	H. F. Webb Co., Portland, Me. White Cross Maine Sugar Fine Quality
27676	R. C. Williams & Co., New York. Famous Royal Scarlet Brand Evergreen
27820	Wilson Canning Co, Mexico, N. Y. Lily Brand Sweet
27905	Winters & Prophet Canning Co., Mount Morris, N. Y. Empire Sweet *First Quality*
27922	Winters & Prophet Canning Co., Mount Morris, N. Y. Revere Brand Sweet First Quality
27896	A. F. York, Yarmouthville, Me. Maine Standard
	Maximum

CANNED CORN.

Cost per Can.	Dry Matter per Can.	Gross Weight.	Weight of Can.	Net Weight of Contents.	Completeness of Fill (Air-space).	Corrosion of Can.	Water.	Dry Matter.
cts.	gms.	gms.	gms.	gms.	in.		%	%
9	118	724	110	614	⅝	Sl.	80.76	19.24
12	130	702	98	604	⅜	Tr.	78.45	21.55
12	122	692	103	589	½	Sl.	79.24	20.76
15	138	710	103	607	⅜	Cons.	77.31	22.69
10	146	689	97	592	¾	Sl.	75.40	24.60
12	140	703	100	603	½	"	76.73	23.27
10	120	697	102	595	½	Tr.	79.81	20.19
15	138	713	105	608	⅜	"	77.31	22.69
10	117	703	102	601	⅜	Cons.	80.46	19.54
15	135	689	98	591	⅝	Tr.	77.20	22.80
13	131	686	101	585	⅝	Sl.	77.59	22.41
10	108	693	107	586	½	None.	81.65	18.35
10	117	680	99	581	½	Sl.	79.94	20.06
10	135	712	100	612	⅜	"	77.91	22.09
10	147	693	100	593	⅝	"	75.20	24.80
12	121	680	101	579	⅝	None.	79.12	20.88
10	122	680	103	577	⅝	Tr.	78.88	21.12
13	127	710	104	606	⅜	None.	79.02	20.98
10	128	702	100	602	½	Cons.	78.80	21.20
15	128	699	104	595	½	Tr.	78.46	21.54
12	130	702	101	601	⅜	Much.	78.41	21.59
10	135	703	101	602	½	Cons.	77.62	22.38
15	109	686	101	585	⅜	Sl.	81.40	18.60
8	122	700	104	596	½	Tr.	79.58	20.42
7	113	691	100	591	½	Sl.	80.94	19.06
10	109	698	99	599	⅜	Tr.	81.82	18.18
12	112	677	99	578	½	Cons.	80.67	19.33
16	144	695	105	590	½	Tr.	75.66	24.34
13	121	685	103	582	½	None.	79.17	20.83
15	108	670	99	571	½	Tr.	81.08	18.92
13	149	713	103	610	¾	None.	75.56	24.44
13	127	699	101	598	⅜	Sl.	78.80	21.20
12	126	680	96	584	½	Tr.	78.39	21.61
15	122	695	100	559	⅜	Sl.	79.55	20.45
15	132	690	99	591	½	None.	77.71	22.29
10	95	662	102	560	⅛	Sl.	83.04	16.96
16	*140*	*724*	*110*	*614*	*¾*	....	*83.04*	*24.80*

TABLE II.—DRIE

Station No.	Manufacturer and Brand.
	Apples.
7931	American Fruit Product Co., Rochester, N. Y. Choice Evap. King Apple
7608	Austin, Nichols & Co., New York. Hudson Brand Evap. Apples.........
7885	Bown Bros., Despatch, N. Y. Star Brand Evap. Apples.................
8002	W. T. Gaylord, Jr., Sodus, N. Y. Snow Flake Choice Evap. Apples.....
7829	W. T. Gaylord, Jr., Sodus, N. Y. Snow Flake Choice Evap. Apples.....
7984	Gold Medal Brand Evap. Apples, Baldwin's..........................
7909	Hartmann & Burns, Rochester, N. Y. Gold Ribbon Brand Choice Evar Apples..........
7913	Hartmann & Burns, Rochester, N. Y. York State Brand Evap. Apples....
7501	Wm. A. Higgins & Co., New York. Chariot Evap. Apples..............
7743	J. J. Smith, Newark, N. Y. Perfection Brand Extra Choice Evap. Apples.
7799	J. J. Smith, Newark, N. Y. Choice Perfection Brand Evap. Apples......
7908	A. B. Williams Fruit Co., Sodus, N. Y. Puritan Brand Extra Fancy Evar Apples..........
	Apricots.
8001	The F. C. Bushnell Co., New Haven. Butter-nut Fancy Evap. Apricots..
7883	R. C. Williams & Co., New York. Famous Royal Scarlet Brand Fanc Apricots..........

Apples.

Eight of the twelve samples of apples were labeled "Sulphured." In only two samples could sulphur dioxide be detected, the amounts present being 1.2 and 0.9 mgm. per 100 gms. of fruit. The absence of sulphurous acid or the presence of these very small quantities is explained by the fact that apples are dried with artificial heat, and after bleaching with the fumes of burning sulphur the drying is effected so quickly that the sulphurous acid dextrose compound is rarely formed and even if formed generally disappears completely during storage. Several of the samples contained noticeable amounts of core, decayed spots, and in one case seeds. Two samples consisted mostly of small pieces and were of inferior quality.

APPLES AND APRICOTS.

Claims of Label.	Net weight. At time of purchase.	Net weight. After days specified.	Days between weights.	Cost per package.	Cost per lb. of fruit, based on 1st net weight.	Remarks.
	oz.	oz.		cts.	cts.	
Net weight when packed 1 lb.	15.3	13.2	70	14	14.6	....
Net weight when packed 16 oz. Sulphur bleached...........	14.0	12.8	85	18	20.6	Some slightly moldy
"Sulphured" indistinctly stamped..................	*11.0*	*10.7*	*71*	*15*	*21.8*	*Some decay; poor condition*
Sulphured	13.7	12.4	64	15	17.5	....
Sulphured	13.3	10.3	75	12	14.4	Some decay
....	12.6	11.9	68	13	16.5	Some decay; many small piec
Sulphured	13.9	13.0	71	15	17.3	Some decay
Sulphured	13.6	*11.1*	71	15	17.6	Some decay; many small piec
....	13.4	10.6	91	12	14.3	....
....	13.4	11.4	79	15	17.9	A good many seeds
Sulphur Processed...........	*12.6*	*11.2*	*76*	*15*	*19.0*	....
"Prepared by Sulphur Process which retains all the natural properties of fresh apples"..................	14.5	13.7	71	20	22.1	....
....	13.5	12.7	64	18	21.3	57.4 mgms. SO_2 per 100 gms A few worms; casts; in b condition
Bleached with Sulphur.......	15.1	13.6	76	25	26.5	56.7 mgms. SO_2 per 100 gms Good condition

The apples cost from 12 to 20 cents per package, weighing at time of purchase from 11 to 15.3 ozs., the cost per pound of fruit ranging from 14.3 to 22.1 cents.

Apricots.

Both samples of apricots contained sulphur dioxide, No. **28001**, 57.4 mgms. and No. **27883**, 56.7 mgms. per 100 gms. of fruit; in the former sample the presence of the bleaching agent was not declared on the label. This sample was also in bad condition, containing a few live worms, and many insect casts.

The apricots cost 18 and 25 cents per package, weighing at time of purchase 13.5 and 15.1 ozs., making the cost per pound of fruit 21.3 and 26.5 cents, respectively.

LIBRA...

TABLE III.—DRIED CURRANTS.

Manufacturer and Brand.	Claims of Label.	Net Weight. At time of purchase.	Net Weight. After days specified.	Days between weights.	Cost per package.	Cost per lb. of fruit based on 1st net weight.	Ash. Total.	Ash. Insoluble in Hcl.	Ash. Soluble in Hcl.
		oz.	oz.		cts.	cts.			
Austin, Nichols & Co., New York. Sunbeam Pure Food	Cleaned	15.7	14.5	77	12	12.2	2.19	0.15	2.04
The F. C. Bushnell Co., New Haven. Butter-Nut Brand, Fancy	Cleaned	15.3	14.1	72	12	12.5	1.92	0.06	1.86
Excelsior Brand	Washed	11.1	9.9	65	11	15.9	2.55	0.50	2.05
Gold Medal Brand, Superior	Cleaned	11.6	13.9	76	12	16.6	2.29	0.33	1.96
Great Atlantic and Pacific Tea Co., Jersey City. Grandmother's Brand, A. & P.	Cleaned	16.0	14.7	86	10	10.0	2.50	0.41	2.09
Herald Brand Greek	...	14.9	14.4	86	10	10.7	3.61	1.61	2.00
Wm. A. Higgins & Co., New York. Chariot	Cleaned	14.4	13.3	87	12	13.3	2.01	0.04	1.97
Wm. A. Higgins & Co., New York. *Holly*	Cleaned	14.4	12.9	85	10	11.1	2.40	0.40	2.00
The Hills Bros. Co., New York. Dromedary Brand	Cleaned	15.1	14.5	87	10	10.6	2.01	0.25	1.76
The Hills Bros. Co., New York. Dromedary Brand	Cleaned	14.4	14.2	70	15	16.7	1.96	0.09	1.87
The Hills Bros. Co., New York. Royal Excelsior Brand	Perfectly Cleaned	15.0	14.7	87	12	12.8	2.14	0.36	1.78
The Hoover Mercantile Co., New York. Battleship Brand	Cleaned	15.5	14.6	84	12	12.4	2.03	0.21	1.82
The E. S. Kibbe Co., Hartford. Helmet Brand	Perfectly Cleaned, 1 lb.	16.2	15.0	69	13	12.8	2.50	0.32	2.18
Frank P. Kruger, New York. Blue Seal	Cleaned	11.0	10.4	85	9	13.1	2.64	0.52	2.12
Frank P. Kruger, New York. Purity	Cleaned	14.3	13.5	80	12	13.4	2.65	0.51	2.14
Francis H. Leggett & Co., New York. Nabob	Cleaned	14.6	14.4	70	13	14.2	2.21	0.23	1.98
Little Jack Horner Brand, Greek	...	14.5	13.4	72	12	13.2	2.69	0.64	2.05
Sunflower Brand, Greek	Cleaned	11.4	10.3	71	12	16.8	2.31	0.43	1.88

Currants.

Eighteen samples were examined, all but two being labeled as cleaned or washed currants. Currants are commonly dried on sand, and unless later carefully cleaned may contain considerable mineral impurity. The total ash in the samples ranged from 1.92 to 3.61, average, 2.37 per cent.; the ash insoluble in hydrochloric acid (sand) from 0.06 to 1.61, average, 0.39 per cent.; the ash soluble in hydrochloric acid from 1.76 to 2.18, average, 1.98 per cent. Total ash is hardly a criterion as to the amount of mineral impurity, as the presence of varying amounts of seeds would affect the ash content. Insoluble ash, however, shows very closely the amount of sand. Three samples contained less

TABLE IV.—DATES AND PRUNES.

Station No.	Manufacturer and Brand.	Net weight. At time of purchase.	Net weight. After days specified.	Days between weights.	Cost per package.	Cost per lb. of fruit, based on 1st net weight.
	Dates.	oz.	oz.		cts.	cts.
27629	Austin, Nichols & Co., New York. Sunbeam Pure Food Golden Dates	16.1*	15.7	144	10	9.9
27878	Austin, Nichols & Co., New York. Sunbeam Pure Food Pitted Dates	12.5†	10.8	133	15	19.2
27613	The Hills Bros. Co., New York. Dromedary Brand Golden Dates	13.3	12.5	144	12	14.4
27659	The Hills Bros. Co., New York. Royal Excelsior Selected Hallowi Dates	10.1	9.3	142	10	15.8
27641	Frank P. Kruger, New York. Purity Brand Persian Dates	12.0	11.2	143	10	13.3
27777	E. A. O'Kelly & Co., Marseille. O'K Dattes Muscades sur Choix	9.2‡	7.3	135	25	43.5
27640	Palmer & Pierce, New York. Orient Brand Golden Dates	11.5	10.8	143	10	13.9
27810	R. C. Williams & Co., New York. Pitted Dates Hallowee, First Quality	10.4	9.4	134	12	18.5
	Prunes.					
26938	The Very Best Prunes Gold Medal Brand Pitted. Santa Clara Co., Cal.	13.5	11.3	150	15	17.8
27881	Lawrence Russell, Saratoga, Cal. Russell Brand Extra Fancy Saratoga Prunes	15.4	13.1	133	17	17.7

* Claimed net wgt. when packed 16 oz.
† Claimed net wgt. when packed 12 oz.
‡ In pasteboard box with loose cover.

than 0.10 per cent., namely, 0.06, 0.04 and 0.09, and show how thoroughly it is possible to clean a high-grade article. Eight samples contained from 0.15 to 0.40 per cent., five from 0.41 to 0.64, and one 1.61 per cent. insoluble ash. The two samples containing the highest percentages were the only ones making no claims for superior cleanliness on the label. Samples containing over 0.25 per cent. of sand cannot justly be called "clean."

TABLE V.

Station No.	Manufacturer and Brand.	Style o: packag
27819	Arguimbau & Ramée, New York. Armée Brand Smyrna Figs	Box
27809	" " " Armée Brand Fancy Figs	Jar
27665	Armée Superbos Brand Extra Fancy Locoums Washed and Conserved Figs	Baske
27770	Austin, Nichols & Co., New York. Anco Washed Figs	Tumble
27947	" " " Sunbeam Pure Food Washed Figs	Jar
27982	Bengal Brand Washed Figs (Serial No. 14902)	"
27660	W. A. Camp & Co., New York. Antler Brand Washed Figs	Box
27776	" " " Jester Brand Washed Figs	Baske
27988	J. C. Carpenter Fig Co., Houston, Tex. Imperial Skinless Figs	Jar
27811	Cresca Figs	Baske
27805	Guggenhine & Co., California. Pansy Brand California Figs	Pape
27918	Hills Bros. Co., New York. Choice Anchor Brand Washed and Conserved Figs	Baske
27774	Hills Bros. Co., New York. Coronet Brand Smyrna Figs	Box
27731	" " " Dromedary Brand Washed and Conserved Figs	"
27948	Hills Bros. Co., New York. Liberty Bell Brand Washed and Conserved Figs	Baske
27987	Imperial Brand Oriental Washed Figs	"
27910	Lesbian Fruit Co. Lesbian Brand Washed Figs Extra Quality	Box
27880	Antoine Reggio & Co., Smyrna, Turkey. Turkey Brand Figs	Pape
27775	Rosenberg Bros. & Co., San Francisco, Cal. Sultan Brand Fancy California Figs	"
27733	Seeman Bros., New York. White Rose Brand Smyrna Figs	Baske
27732	Smyrna Fruit Co. Erbeyly Brand Pulled Figs	Box
27879	" " Erbeyly Brand Superior Quality Figs	Baske
27603	Van Dyk & Catrevas. Imperial Brand Washed Figs	Box
27773	" " " "	"
27792	" " " "	Jar
27711	White Lily Sterilized Selected Pulled Figs, Packed in Turkey	Box
27919	R. C. Williams & Co., New York. The Famous Royal Scarlet Brand Fresh Figs	Jar
27983	R. C. Williams & Co., New York. Vizier Brand Smyrna Figs	Baske

The cost ranged from 9 to 15 cents per package, weighing at time of purchase from 10.3 to 15 ozs., the cost per pound of fruit ranging from 10 to 16.8 cents.

Dates.

No chemical data were secured with the eight samples of dates. The cost ranged from 10 to 25 cents per package, weighing at

'IGS.

Price per package.	Net weight of Figs.	Polarization. Direct 22°	Polarization. After Inversion 22°	Polarization. After Inversion 87°	Sulphur dioxide per 100 gms.	Claims of Labels.
cts.	oz.				mgms.	
10	5.5	− 7.16	− 8.36	2.78	0	*Washed and conserved in corn syrup*
25	12.1	− 3.98	− 4.76	2.40	0	Prepared with corn syrup.
20	11.7	− 8.16	− 9.04	2.58	0	Prepared in corn syrup.
19	9.2	−11.88	−12.28	0.40	0	
18	9.5	− 9.90	−11.08	2.00	0	Prepared with sugar and corn syrup.
10	5.9	− 7.16	− 7.96	1.20	0	
10	5.6	−17.04	−17.40	1.44	0	Prepared with pure corn syrup.
25	14.7	−11.96	−11.56	0.60	0	Prepared with corn syrup.
35	18.5	+32.40	− 9.68	....	0	
30	14.3*	− 7.52	− 7.92	2.78	0	Prepared with corn syrup.
9	9.2	−18.30	−18.48	0.36	16.6	Bleached with sulphur.
25	9.9	−11.58	−12.40	1.40	0	Prepared with corn syrup.
10	5.8	−12.38	−12.76	1.00	0	Washed and conserved in corn syrup
10	5.5	− 9.18	− 9.16	3.00	0	Conserved in corn syrup.
25	10.6	− 8.98	− 9.60	2.00	0	Prepared with corn syrup.
22	12.0	− 8.32	− 8.72	1.20	0	
10	4.9	− 4.00	− 4.20	2.20	0	
14	10.9	− 9.94	−10.32	1.40	0	
5	3.5	−18.34	−18.32	0.00	45.3	
30	13.2	−13.96	−13.92	0.00	0	Prepared with sugar and corn syrup
25	14.6	−11.94	−12.76	0.60	0	" " " " " "
25	13.8†	− 7.98	− 8.76	2.00	0	" " " " " "
10	4.7	− 8.18	− 9.76	3.08	0	Prepared with corn syrup.
25	11.2	− 8.00	− 8.40	2.60	0	" " " "
15	9.7	− 8.76	− 9.96	1.80	0	" " " "
20	13.1	−12.36	−12.76	1.00	0	
35	13.0	− 4.80	− 6.00	0.80	0	Prepared with corn syrup.
23	13.0	−11.98	−11.60	1.40	0	Prepared with sugar and corn syrup

* Claimed 1 lb. net weight. † Claimed 13.5 oz. net when packed.

	Manufacturer and Brand.	Claimed Weight.	At time of purchase.	After day specified	Days between weights	Cost per	Cost per fruit basis net
			oz.	oz.		cts.	cts.
8	American Vineyard Co., Fresno, Cal. The Ideal "Not-A-Seed" Raisins.	......	15.4	15.0	75	12	12.5
1	Antler Brand Fancy Seeded Raisins	......	16.0	15.2	70	12	12.0
1	The J. K. Armsby Co., Fresno, Cal. Owl Brand Fancy Seeded Raisins	......	15.8	15.3	78	12	12.2
4	Austin, Nichols & Co., New York. Violet Seeded Raisins	......	15.5	15.0	85	14	14.5
8	Blue Seal Extra Fancy Seedless Raisins	......	10.6	9.2	83	9	13.6
7	The F. C. Bushnell Co., New Haven. Butter-Nut Brand Fancy Seeded Raisins	......	15.4	14.7	74	13	13.5
6	California Fruit Canners Asso., Fresno, Cal. Del Monte Brand Fancy Seeded Raisins	......	15.7	15.5	85	13	13.2
8	Castle Bros., Cal. *Castle Brand Selected Raisins*	......	13.9	12.5	63	16	18.4
4	Castle Bros., Cal. Castle Brand Fancy Thompson Seedless Raisins	......	15.4	14.6	83	10	10.4
7	Clark, Chapin & Bushnell, New York. Diamond Brand Sultana Raisins	......	14.9	14.1	63	25	26.8
6	Lewis De Groff & Son, New York. Health Brand Seeded Raisins	......	14.5	14.0	70	15	16.6
6	*El Cajon Raisin Co.*, El Cajon, Cal. Hibiscus Brand Fancy Seeded Raisins	1 lb. gross when packed	15.9	15.1	84	13	13.1
8	Ellis Bros., Fresno, Cal. Dandy Brand Fancy Seeded Raisins	......	11.4	11.1	74	9	12.6
9	*Fresno Home Packing Co.*, Fresno, Cal. Blue Ribbon Fancy Seeded Raisins	......	16.3	15.7	82	13	12.8
5	Gold Medal Brand Seeded Raisins, Finest Quality California Loose Muscatels	......	14.9	14.4	65	15	16.1
8	Great Atl. & Pac. Tea Co., Jersey City, N. J. Grandmother's Brand A. & P. Seeded Raisins	......	15.9	15.5	85	10	10.1
0	*Wm. A. Higgins & Co., New York. Golden Wedding Seedless Sultana Raisins	......	14.3	13.4	85	16	17.9
8	The Hills Bros. Co., New York. *Royal Excelsior Brand Seeded Raisins*	......	13.7	13.2	76	13	15.2
7	Kings Co. Raisin & Fruit Co. Red Bird Choice Seeded Raisins	......	15.3	15.0	85	10	10.5
0	*Francis H. Leggett & Co.*, New York. Premier Brand Seeded Raisins	......	15.3	14.5	85	13	13.6
1	Madison & Bonner, Fresno, Cal. California Seal Brand Seeded Raisins	......	16.6	15.8	75	10	9.6
5	*Malaga Packing Co., Malaga, Cal.* Floresca Brand Fancy Seeded Raisins	*15-16 oz. gross when packed*	15.5	15.1	83	12	12.4
9	Malaga Packing Co., Malaga, Cal. Malpago Brand Thompson Seedless Raisins	......	15.5	14.9	67	12	12.4
0	Meyer & Lange, New York. "*Au Gourmet*" *Finest* Cleaned Sultana Raisins	1 lb.	14.6	14.4	67	17	18.6
7	North Ontario Packing Co., Cal. Glen Rosa Brand Fancy Seeded Raisins	......	16.0	15.7	85	11	11.0
1	Seeman Bros., New York. White Rose California Seeded Muscatel Raisins	......	16.3	15.6	68	12	11.8
2	Selma Fruit Co., Selma, Cal. Pheasant Brand Fancy Seeded Raisins	......	16.0	15.6	74	17	17.0
2	Stoddard, Gilbert & Co., New Haven. Hermitage Brand Fancy Seeded Raisins	......	16.1	15.2	70	12	11.9
8	The Twitchell-Champlin Co., Portland, Me. Hatchet Brand Seeded *Raisins*	......	14.7	14.5	67	12	13.1
9	The Union Pacific Tea Co., New York. Sovereign Brand Fancy Seeded Raisins	......	14.2	13.8	84	11	12.4

time of purchase from 9.2 to 16.1 ozs., the cost per pound of fruit ranging from 9.9 to 43.5 cents, an extremely wide variation.

Figs.

Twenty-eight samples were examined, nineteen of which were labeled as prepared with corn syrup and five as prepared with sugar as well. The polarizations showed wide variations, direct at 22° C. from —3.98 to —18.34; after inversion at 22° C. from —4.20 to —18.48; after inversion at 87° C. from ±0.00 to +3.08. Neither the amount of cane sugar or glucose used was large in any case, except in **27988** where the figs were packed in sugar syrup.

Two samples contained sulphur dioxide, No. **27805**, 16.6 mgms., and No. **27775**, 45.3 mgms. per 100 gms. of figs; in the latter sample the sulphur dioxide was not declared on the label.

The size and nature of the packages of figs varied so much that a comparison as to cost is hardly satisfactory.

Prunes.

The cost of the two samples was 15 and 17 cents per package, weighing 13.5 and 15.4 ozs., respectively, at time of purchase.

Raisins.

Thirty-two samples of raisins were examined. Only one sample contained sulphur dioxide, No. **27620**, a brand of Sultana raisins, containing 17.3 mgms. per 100 gms. of raisins; this was not declared on the label.

The cost ranged from 9 to 25 cents per package, weighing at time of purchase from 11.4 to 16.6 ozs., the cost per pound of fruit ranging from 9.6 to 26.8 cents.

GLUTEN AND SPECIAL FOODS.

Eleven samples of gluten foods and similar preparations were examined. While some of these were not specially recommended for use by diabetics, the chief use of a gluten preparation is to provide a food rich in nitrogenous compounds and as poor as possible in starch. Some of these samples are excellent from this standpoint, while others contain so much starch that their claims

TABLE VII.—GLUTEN FOODS AND SPECIAL PREPARATIONS.

Brand.	Net weight of sample.	Cost per package.	Cost per lb.	Water.	Ether Extract.	Fiber.	Protein (N x 6.25).	Ash.	Nitrogen-free Extract.	Starch.
	oz.	cts.	cts.							
Akoll Biscuit	4.0	22	80	9.25	26.88	0.38	53.19	3.88	6.42	1.53
[1]Brusson Diabetic Bread	1.2	10	133	12.70	1.83	0.26	37.25	0.80	47.16	40.14
Barker's Gluten Food. Herman Barker, Somerville, Mass.	12.8	125	156	7.42	0.52	0.23	86.88	0.35	4.60	0.00
[2]Soy Bean Gruel Flour. Cereo Co., Tappan, N. Y.	12.4	50	65	4.92	20.49	1.90	45.69	4.44	[3]22.56	0.63
20% Gluten Meal. The Kellogg Food Co., Battle Creek, Mich.	15.1	25	26	9.77	0.46	0.13	27.50	1.42	60.72	49.64
40% Gluten. The Kellogg Food Co., Battle Creek, Mich.	11.3	50	71	9.72	0.89	0.16	47.00	1.38	40.85	31.86
80% Gluten. The Kellogg Food Co., Battle Creek, Mich.	15.0	60	64	9.05	0.92	0.17	81.25	0.58	8.03	6.21
Avena-Gluten Biscuit Mixture. The Kellogg Food Co., Battle Creek, Mich.	12.3	25	33	7.93	12.68	0.41	21.38	2.12	55.48	41.13
40% Gluten Biscuit. The Kellogg Food Co., Battle Creek, Mich.	3.1	25	129	10.20	0.49	0.15	47.50	0.48	41.18	35.01
80% Gluten Biscuit. The Kellogg Food Co., Battle Creek, Mich.	6.7	30	72	10.09	0.87	0.06	82.38	2.08	4.52	4.68
Breakfast Toast. The Kellogg Food Co., Battle Creek, Mich.	9.0	13	23	7.70	1.92	0.26	13.63	1.60	74.89	57.42

imed 35 per cent. protein. [2]Claimed 44 per cent. protein, 20 fat, 10 cane sugar and a trace of starch. [3]9.11 per cent. cane sugar.

to be diabetic foods are unfounded if not fraudulent, and their use by diabetic patients attended with considerable danger.

Akoll Biscuit has high percentages of protein and fat, and a very low content of starch.

Brusson Diabetic Bread, while it exceeds its protein guaranty, cannot be recommended for use by diabetics because of its high starch content, over 40 per cent.

Barker's Gluten Food makes no specific claim on its label, yet it contains nearly 87 per cent. of protein, higher than any other sample examined, and no starch whatever.

Soy Bean Gruel Flour (Cereo Co.) contains a fairly high percentage of protein, high fat and only a trace of starch. It contains about 9 per cent. of cane sugar, doubtless added to increase its palatability.

20% Gluten Meal (Kellogg's) bears this statement on the label, "It is claimed for 20% Gluten that a large portion of the starch has been removed, and experience shows that it is better adapted to all but exceptional cases than is pure Gluten, besides being more palatable and less expensive." While it is true that modern medical practice in diabetes permits the use of food containing as much starch as the patient can normally assimilate, it would certainly be an "exceptional case" where a preparation containing nearly 50 per cent. of starch could be recommended for a sufferer from diabetes.

40% Gluten (Kellogg's) bears these statements: "Prepared by a process which almost wholly excludes all the elements with the exception of gluten," "This food is absolutely indispensable to persons suffering with Diabetes, a disease which is better controlled by its use than by any other known means." A preparation containing nearly 32 per cent. of starch cannot be said to have the starch "almost wholly" excluded. A food containing so much starch cannot be "absolutely indispensable" to diabetics, and that by the use of such a food diabetes is better controlled "than by any other known means" is of more than doubtful truthfulness. The following sample bears exactly the same claim, which obviously cannot be true for both of two such dissimilar products.

80% Gluten (Kellogg's) bears exactly the same claims as the *40% Gluten.* This preparation is a high-grade article, containing over 81 per cent. of protein and only a small amount of starch.

The above claim, relieved of some of its exaggeration, might fairly be applied to a food of this nature.

Arena-Gluten Biscuit Mixture (Kellogg's) claims to be made from oatmeal and wheat gluten "especially for the use of Diabetics." Once more we repeat that a material containing 41 per cent. of starch is not safe or desirable food to recommend generally for diabetics.

40% Gluten Biscuit (Kellogg's) claims "Good for Well Folks—Best for Diabetics—Well for All Folks." Containing as it does 35 per cent. of starch it certainly is not "best for diabetics."

80% Gluten Biscuit (Kellogg's) bears the same claim as the preceding sample and with much more justification. It contains over 82 per cent. of protein and less than 5 per cent. of starch.

Breakfast Toast (Kellogg's) claims to be "prepared from whole wheat bread made from hulled wheat flour dextrinized, partly predigested. Retains all the food value of wheat." How "hulled" wheat flour can make "whole" wheat bread is difficult to understand. The claim for partial predigestion probably rests on the assertion that the flour is dextrinized. It has been dextrinized only in small part, as over 57 per cent. of raw starch remains.

The preparation of foods containing much gluten and little starch is an expensive process and high prices must be charged for the resultant foods. But when a diabetic patient pays a high price for a food which is claimed to meet his particular needs, and analysis shows that the food is utterly unfitted for his requirements, he is defrauded and, depending on the manufacturer's claims, pays his good money for a food which may work actual harm upon him.

For convenience of reference the various analyses of diabetic and gluten preparations made at this station since 1906 are collected in Table VIIa. Sixty-four other analyses made by this station are given in the Report for 1906, page 156.

HONEY.

The official standard for honey is as follows:

"Honey is the nectar and saccharine exudations of plants gathered, modified and stored in the comb by honey bees (*Apis mellifica* and *A. dorsata*); is laevo-rotatory, contains not more than twenty-five (25)

(Supplemental to Table XVI, Rept. 1900, p. 150.)

Material.	Manufacturer.	Analysis of Material as purchased.						
		Water.	Ash.	Protein (Nx6.25).	Fiber.	Nitrogen-free extract.	Fat.	Starch.
Flour and Meal.								
arker's Gluten Food	Herman Barker, Somerville, Mass.	7.42	0.35	86.88	0.23	4.60	0.52	0.00
oy Bean Gruel Flour	Cereo Co., Tappan, N. Y.	4.92	4.44	45.69	1.90	22.56*	20.49	0.63
. B. X. (Cold Blast Extra Flour) 25% Protein	The *Health Food Co.*, New York	8.71	0.51	10.13	0.15	79.63	0.87	68.85
r. Johnson's Educator Standard Gluten Flour	Johnson Educator Food Co., Boston	7.32	0.82	40.13	0.23	50.10	1.40	40.91
o% Gluten Meal	The Kellogg Food Co., Battle Creek, Mich.	9.77	1.42	27.50	0.13	60.72	0.46	49.64
o% Gluten	The Kellogg Food Co., Battle Creek, Mich.	9.72	1.38	47.00	0.16	40.85	0.89	31.86
o% Gluten	The Kellogg Food Co., Battle Creek, Mich.	9.05	0.58	81.25	0.17	8.03	0.92	[illegible]6.21
oyt's Gum Gluten Flour	The Pure Gluten Food Co., New York	8.12	1.04	38.25	0.19	50.78	1.62	42.35
luten *Flour (in bulk)*	Sold by D. M. Welch & Son, New Haven	8.73	0.70	18.00	0.17	71.40	1.00	61.61
" "	Sold by D. M. Welch & Son, New Haven	....	....	16.25	....	....	....	....
"	R. O. Bischof, London, Eng.	10.08	1.26	79.75	0.15	5.21	3.55	....
iabetic Flour	Unknown	....	....	38.00	....	....	....	....
" "	"	....	....	17.81	....	....	....	....
Bread, Biscuit, etc.								
koll Biscuit	....	9.25	3.88	53.19	0.38	6.42	26.88	1.53
iabetic *Gluten* Bread	R. O. Bischof, London, Eng.	7.40	4.74	73.13	0.02	14.26	0.45	....
'Essentiel" Bread for Super Alimentation	" "	7.28	4.84	26.63	0.08	59.57	1.60	....
o% Gluten Biscuit	Battle Creek Sanitarium Food Co., Battle Creek, Mich.	8.04	1.63	43.25	0.17	45.71	1.20	35.28

Material.	Manufacturer.	Analysis of Material as purchased.						
		Water	Ash.	Protein (Nx6.25).	Fiber.	Nitrogen-free extract.	Fat.	Starch.
Bread, Biscuit, etc. (continued).								
luten Bread	Brusson Jeune, Villemur, France	12.70	0.80	37.25	0.26	47.16	1.83	40.14
asoid Dinner Rolls	Callard, Stewart & Watt, London, Eng.	....	....	80.81	....	....	....	3.33
asoid Biscuits, Plain, No. 2	" " " " "	....	....	58.12	....	....	....	0.00
asoid Biscuits, Sweet, No. 3	" " " " "	....	....	54.69	....	....	....	0.54
o. 2 Proto Puffs	The Health Food Co., New York	8.15	1.79	52.38	0.22	35.98	1.48	27.18
ducator Gluten Cookies	*Dr. Wm. L. Johnson*	4.75	2.73	26.44	0.31	49.79	15.98	37.80
vena-Gluten Biscuit Mixture	The Kellogg Food Co., Battle Creek, Mich.	7.93	2.12	21.38	0.41	55.48	12.68	41.13
% Gluten Biscuit	*The Kellogg Food Co., Battle Creek, Mich.*	10.20	0.48	47.50	0.15	41.18	0.49	35.01
% Gluten Biscuit	The Kellogg Food Co., Battle Creek, *Mich.*	10.09	2.08	82.38	0.06	4.52	0.87	4.68
iabetic Bread	Unknown	29.60	1.45	21.24	45.11		2.60	33.66
Miscellaneous.								
ranola	Battle Creek Sanitarium Food Co., *Battle Creek, Mich.*	6.14	2.34	13.88	0.64	76.20	0.80	45.23
ates aux Oeufs Macaroni	Brusson Jeune, Villemur, France	8.57	0.68	13.94	Tr.	76.38	0.43	69.21
ermicelle au Gluten Extrait, etc.	" " "	7.96	0.80	18.44	Tr.	72.37	0.43	65.79
ates aux Oeufs Nouillettes	" " "	8.67	0.65	14.38	Tr.	75.77	0.53	68.90
luten Semolina (Semoule du Gluten)	" " "	9.65	0.70	17.19	0.28	71.72	0.46	64.89
anitas Meltose	The Kellogg Food Co., Battle Creek, *Mich.*	26.81	0.46	0.63	....	72.10*	....	....
oyt's Gum Gluten Granules	The Pure Gluten Food Co., New York	7.48	1.46	45.50	0.31	43.70	1.55	32.27
oyt's Gum Gluten Breakfast Food	" " "	7.48	1.23	37.81	0.38	51.77	1.33	37.89
oyt's Gum Gluten *Noodles*	" " "	8.26	1.13	36.56	0.21	51.48	2.36	42.03
oyt's Gluten Macaroni	" " "	10.34	0.74	41.37	0.29	46.28	0.98	....
paghetti	The Marvelli Co., Harbor Beach, Mich.	....	....	15.50	....	....	....	....

per cent. of water, not more than twenty-five hundredths (0.25) per cent. of ash, and not more than eight (8) per cent. of sucrose."

"Chemically considered, the ideal honey is a concentrated solution of invert sugar (i. e. of the sugars dextrose and levulose in equal proportions), with traces of ash, formic acid, nitrogenous bodies, dextrin, and other organic substances not sugar. This ideal type of honey, unfortunately, is the exception, since the impurities so generally introduced by bees from plant juices, honeydew, and other sources affect the composition of honey to a very marked degree. A limit, even if it be an arbitrary one, must therefore be set for the percentage of such impurities, in order that a suitable standard may be maintained for the composition of honeys sold upon the market."*

The adulterants most commonly used at present in honey are cane sugar, commercial glucose and invert sugar. Cane sugar may either be introduced directly or by feeding it to the bees. Glucose in the past has been the most common adulterant of honey. It closely resembles honey in color and consistence, and its ability to prevent granulation even when used in very small quantities is a strong incentive to its use. Invert sugar has long been a favorite adulterant of honey, and as honey itself consists of nearly three-quarters invert sugar, its detection is rather difficult. The present examination was confined chiefly to the three adulterants just enumerated.

Twenty-six samples of bottled strained honey were analyzed. Nos. **27500, 27598, 27599, 27600, 27636, 27708, 27804, 27894, 27920** and **27967** showed more or less granulation. The color ranged from almost colorless to brown.

The methods of analysis used were essentially those employed by Browne (see reference above). To avoid the error due to birotation, the solutions were allowed to stand for twenty hours before making the direct polarization. In many of the samples crystallization had begun; these were carefully heated to 45° to 50° C. until complete solution was effected, and the samples then cooled to room temperature.

Direct polarization was made at 22° and 87° C., and the invert polarization at the same temperatures. Invert sugar was determined as total reducing sugars, using 10 gms. of honey, and 2 cc. of alumina cream making up to 50 cc. with water. After filtering, 10 cc. of the filtrate was made up to 200 cc. with water, and 20 cc. (= .2 gm. honey) used for the determination. Free acidity is reported as formic acid, although it is recognized that other acids may be present.

* Browne: U. S. Dept. Agl. Bur. of Chem., Bull. *110*, p. 10.

TABLE VIII.—

Station No.	Manufacturer and Brand.
27599	[6]W. H. Archer, Port Chester, N. Y. Warranted Pure White Clover Honey........
27598	[2]Austin, Nichols and Co., New York. Busy Bee Brand Pure Extracted Honey........
27673	[2]*Austin, Nichols and Co., New York. Sunbeam Pure Food Honey.* .
27894	[4]A. C. Bristol, Meriden. Pure Honey........
27600	[4]H. W. Coley, Westport. Warranted Pure Honey........
27772	[3]Lewis DeGroff and Son, New York. Health Brand Pure Honey......
27884	[4]W. H. Dickinson, Middletown. Extracted Honey Warranted Pure..
27791	[2]Falcon Packing Co., New York. Falcon Brand Pure Honey........
27986	[4]W. D. Foote, Westville. Pure Honey........
27771	[6]C. S. Guernsey, Thomaston........
27769	[4]C. P. Heinze, Woodbury........
27968	[2]Hildreth and Segelken, New York. Pure California White Sage Honey
27808	[3]*Humbert and Andrews, Brooklyn, N. Y. Acme Brand Pure Strained* Honey........
27942	[4]W. J. Lamb Co., W. Somerville, Mass. Pure Florida Honey........
27708	[3]P. W. Latham and Co., Norwich. Guaranteed Pure Honey........
27597	[1]Francis H. Leggett and Co., New York. Premier Pure Strained Honey
27601	[3]Jos. M. McCane and Son, New York. Orange Bloom Brand Pure Honey........
27985	[3]Montclair Jam Kitchens, Montclair, N. J. Highest Grade Honey....
27500	[3]New England Maple Syrup Co., Boston. Golden Tree Pure Honey
27602	[2]Frank L. Park, White Plains, N. Y. Warranted Pure Honey........
27734	[1]The Royal Cheese Co., Detroit, Mich. Royal B Absolutely Pure Honey........
27967	[1]Simpson Spring Co., So. Easton, Mass. Gold Label Pure Honey.....
27804	[4]Simpson Spring Co., So. Easton, Mass. Victor Brand Pure Honey..
27636	[2]Vermont Maple Syrup Co., New Haven. Pride of the Farm Brand Pure Honey........
27920	[2]R. C. Williams and Co., New York. Famous Royal Scarlet Brand Pure Honey........
27672	[2]R. C. Williams and Co., New York. Famous Royal Scarlet Brand Pure Honey........
	Maximum........
	Minimum........
	Average........

[1]Nearly colorless. [2]Pale straw color. [3]Deep straw color. [4]Yellow. [5]Yellow brown. [6]Brown.

Polarization. The direct polarization ranged from —2.4 to —27.5, average, —15.6, at 22° C., and from +1.5 to +20.0, average +9.2, at 87° C. The invert polarization ranged from —5.94 to —31.24, at 22° C., and from ±0.0 to +19.2, at 87° C. Browne has pointed out (see reference above)

HONEY.

Cost per bottle.	Net weight of contents.	Cost per lb. of Honey.	Polarization. Direct. 22° C.	87° C.	Invert. 22° C.	87° C.	Difference.	Invert Sugar.	Free Acidity as Formic.	Ash.
cts.	oz.	cts.								
15	7.4	32.4	−16.6	+ 9.0	−19.58	+ 5.2	24.78	74.30	0.12	0.25
10	7.7	20.8	−15.3	+ 9.0	−19.47	+ 6.0	25.47	70.70	0.09	0.04
10	[7]4.9	32.7	−14.0	+ 8.4	−21.78	+ 6.8	28.58	66.60	0.06	0.06
25	14.8	27.0	−15.6	+ 8.0	−18.26	+ 8.0	26.26	72.15	0.14	0.17
25	14.6	27.4	−17.0	+ 6.6	−20.24	+ 6.0	26.24	74.75	0.17	0.11
25	12.9	31.0	−15.4	+ 8.2	−20.46	+ 6.6	27.06	66.80	0.12	0.24
35	22.3	25.1	− 9.3	+15.5	−13.64	+10.6	24.24	67.90	0.09	0.14
15	5.3	45.3	−17.2	+ 9.2	−20.35	+ 7.8	28.15	72.45	0.09	0.09
20	10.7	30.0	−23.3	+ 6.8	−25.96	+ 5.0	30.96	71.20	0.10	0.18
25	15.7	25.5	− 2.4	+19.6	− 6.27	+17.0	23.27	66.45	0.15	0.35
25	11.6	34.5	− 2.9	+20.0	− 5.94	+19.2	25.14	68.45	0.10	0.26
10	6.8	23.5	−21.4	+ 6.0	−23.32	+ 5.6	28.92	73.20	0.08	0.12
25	18.7	21.4	−15.4	+10.2	−21.12	+ 8.0	29.12	71.45	0.08	0.18
25	14.5	27.6	−24.7	+ 2.6	−27.50	+ 2.0	29.50	69.35	0.12	0.12
18	10.5	27.4	− 9.2	+14.3	−13.64	+10.4	24.04	72.20	0.09	0.23
10	[8]6.9	23.2	−17.0	+ 7.8	−25.08	+ 4.8	29.88	70.50	0.07	0.06
15	[9]7.2	33.3	−12.5	+10.8	−21.45	+ 5.0	26.45	65.45	0.13	0.10
25	17.0	23.5	−13.1	+11.4	−15.40	+ 8.0	23.40	73.20	0.07	0.36
10	6.7	23.9	−15.6	+ 7.6	−20.79	+ 5.8	26.59	76.53	0.08	0.04
25	14.7	27.2	−27.5	+ 1.5	−31.24	± 0.0	31.24	73.25	0.14	0.15
10	6.4	25.0	−20.1	+ 6.3	−25.08	+ 6.2	31.28	73.70	0.07	0.03
10	4.5	25.6	−17.6	+ 7.3	−23.32	+ 6.0	29.32	71.50	0.07	0.09
10	6.3	25.4	−18.2	+ 9.0	−19.80	+ 7.4	27.20	74.60	0.10	0.21
10	8.8	18.2	−20.0	+ 2.0	−23.32	+ 2.0	25.32	72.90	0.09	0.18
10	5.3	30.2	−14.0	+10.8	−20.24	+ 8.0	28.24	71.45	0.07	0.09
25	13.8	29.0	−11.3	+10.5	−22.88	+ 6.0	28.88	71.05	0.06	0.06
		45.3	**−27.5**	**+20.0**	**−31.24**	**+19.2**	**31.28**	**76.53**	**0.17**	**0.36**
		18.2	**− 2.4**	**+ 1.5**	**− 5.94**	**± 0.0**	**23.27**	**65.45**	**0.06**	**0.03**
		27.9	**−15.6**	**+ 9.2**	**−20.24**	**+7.05**	**27.29**	**71.23**	**0.10**	**0.15**

[7]Claimed net wgt., 4¼ oz. [8]Claimed net wgt., about 5⅔ oz.
[9]Claimed net wgt., about 8 oz.

that the difference between the invert polarizations at 20° and 87° C. is fairly constant for nearly all honeys, 95 per cent. of the samples he examined ranging from 23 to 30. The range of difference in our samples may be summarized as follows:—

No. of Samples.	Degrees Ventzke.
5	23-25
7	25-27
7	27-29
4	29-30
3	30-32

The range was from 23.27 to 31.28, average, 27.29, as compared with Browne's average of 26.71 for pure honey. There is nothing in these values, considered by themselves, to indicate any adulteration in our samples.

Calculation of sucrose in honey by the Clerget formula may introduce an error, in some cases exceeding one per cent. Such a calculation may be used, however, as a rough means of determining the presence of excessive sucrose. By this formula our samples showed from 1.22 to 8.80 per cent. sucrose, values which are probably too high in all cases. As the official standard permits as much as 8 per cent. of sucrose, all these samples may be considered as satisfying the standard in this respect.

Commercial Glucose. The A. O. A. C. method for estimating glucose in honey consists in polarizing the inverted solution at 87° C., multiplying this reading by 100 and dividing by 163. The fact that all honeys are more or less dextrorotatory at 87°, makes it necessary to use extreme caution in this method of calculating glucose.

Another method of calculation, much used in Europe, is based upon the variation in the invert polarization of the sample from the average polarization of pure honey. Using Browne's values for pure honey this formula would be $y = \frac{P + 17.5}{193}$, in which y = per cent. of commercial glucose and P = invert polarization Ventzke of normal weight of sample. This method, while giving somewhat better results than the A. O. A. C. method, makes no allowance for the wide range in the invert polarization of pure honeys (—29.26 to +14.96), thus making possible a considerable error.

Browne suggests still a third method of calculation based upon the lowering of the difference in invert polarization between 20° and 87° C.; this difference he found to average 26.7. The difference in invert polarization between 20° and 87° C. is multiplied by 77, the average percentage of invert sugar after inversion for pure honey, and this product is divided by the percentage of invert sugar after inversion found in the sample. This quotient multiplied by 100 and divided by 26.7, gives the percentage of pure honey in the sample.

All the samples were tested by these three methods of calculation. Only five samples were somewhat suspicious because of the rather high plus polarization at 87°. The figures were as follows:

No.	Per cent. of Glucose. A. O. A. C. Method.	European Method.	Browne Method.
27708	6.38	2.00	4.1
27769	11.78	5.99	0
27771	10.43	5.82	0
27884	6.54	2.00	0
27985	4.91	1.09	7.9

Owing to the existing uncertainty in all these methods of calculation the Beckmann test* was applied to these doubtful samples. The results were negative in each case.

Invert Sugar. The invert sugar ranged from 65.45 to 76.53, average, 71.23 per cent., all well within the limits for pure honey. It is possible that some of the lower percentages may be due to the presence of excessive water, but this point was not determined. All the samples were tested for added invert sugar by Ley's ammoniacal-silver test† and by the anilin-acetate test‡. In four cases the latter test gave slight indications of the presence of added invert sugar, but no absolutely positive results.

Free Acidity. The free acidity, calculated as formic, ranged from 0.06 to 0.17, average, 0.10 per cent., all well within the usual accepted limits.

Ash. The ash ranged from 0.03 to 0.36, average, 0.15 per cent., only two samples exceeding the standard's maximum, 0.25 per cent.

Summary.

While in a few cases certain tests indicate the presence of a small amount of glucose, and in two instances the percentage of ash exceeds the standard, we do not feel justified in condemning any sample as adulterated or otherwise illegal. There are wide variations in quality but all the samples appear to be genuine honeys of varying origins.

In three samples a definite net weight was claimed; in two of these the weight delivered considerably exceeded that claimed; in **27601**, however, there was a shortage of ten per cent. The cost per pound of honey ranged from 18.2 to 45.3 cents, with an average of 27.9 cents, depending to some degree on the size of the package, and probably, in certain cases, on the quality of the honey.

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* Zeit. anal. Chem., 1896, *35*, 267.
† Pharm. Zeit., 1902, *47*, 603.
‡ Bur. of Chem., Bull. *110*, 68.

RICE.

Partly in response to a popular demand for a perfectly white product, and partly to make a low-grade article appear of superior quality, the practice of "facing" or "polishing" rice has become very general. Formerly the polishing was effected by shaking the rice in a bag of sheepskin or other suitable material. Of late, however, the rice has been polished either by the use of paraffin oil or by talc in connection with a small amount of glucose. The word "talc" is used here in a broad sense. It is almost impossible to identify absolutely the mineral matter used, for french chalk, talc and steatite, substances whose use has been suggested, show relatively small differences in composition as regards their chief ingredients, silica, magnesia and iron and alumina.

The use of talc or similar polishing material is objectionable for several reasons. It is entirely unnecessary, for if polishing must be practiced there are other methods less objectionable. Moreover the demand for white rice is a whimsical fancy of the purchaser, to satisfy which a part of the nutriment of the rice is removed. The amount of foreign mineral matter present is sometimes sufficient to materially affect the weight, which is fraudulent. Furthermore the presence of even small quantities of insoluble mineral matter may be injurious to health because of the irritation it causes and because of the possible formation of fœcal concretions.

It is quite probable that nearly all the polished rice shipped in interstate commerce is so branded as to declare the presence of foreign mineral matter, but it is also true that the retail purchaser is seldom advised of the contamination, when he purchases rice in bulk. In the case of the forty-four samples purchased by us and the eighteen purchased by the Dairy Commissioner, the agent was not informed in a single instance that he was buying polished rice, although over half of the samples were certainly thus polished.

In the present examination only total ash and ash insoluble in hydrochloric acid were determined. Genuine unpolished rice should not contain over 0.30 to 0.40 per cent. of ash, and only a very small part of this should be insoluble in hydrochloric acid. The amount of acid-soluble ash is a fairly constant quantity in

TABLE IX.—RICE NOT FOUND ADULTERATED.

Station No.	Dealer.	Price per lb. cts.	Weight claimed. oz.	Weight found. oz.	Ash, Total.	Ash Insoluble in HCl.	Ash Soluble in HCl.	Appearance of Ash.
27796	*Bridgeport*: Village Store Co.	5	16	16.6	0.41	0.01	0.40	Fused.
27802	Logan Bros. Co.	5	16	16.4	0.50	0.04	0.46	"
27803	Bridgeport Public Market	8	16	16.0	0.35	0.02	0.33	"
27812	The Mohican Co.	8	16	15.9	0.32	0.03	0.29	"
27969	*Hartford*: Wise, Smith & Co.	7	16	16.2	0.45	0.04	0.41	"
27970	H. Griswold	10	16	16.0	0.42	0.06	0.36	"
27971	J. A. Pilgard	9	16	15.7	0.38	0.06	0.32	"
27972	City Hall Grocery	10	16	16.4	0.39	0.04	0.35	"
27977	†Tracy's Grocery	10	16	16.0	0.39	0.01	0.38	"
27900	*Meriden*: Boston Grocery	8	16	16.8	0.35	0.05	0.30	"
27901	N. P. Lamontagne	10	16	16.7	0.34	0.06	0.28	"
27902	Logan Bros. Co.	5	16	16.2	0.50	0.04	0.46	"
27694	*Norwich*: W. J. Townsend	5	16	16.2	0.38	0.04	0.34	"
27815	*New Haven*: D. M. Welch & Son	10	16	16.4	0.34	0.01	0.33	"
27817	M. C. Dingwall	5	16	16.0	0.33	0.02	0.31	"
27614	*South Norwalk*: Royal Grocery Co.	5*	8	9.1	0.41	0.05	0.36	Partly fused.
27615	Atlantic & Pacific Tea Co.	4*	8	8.2	0.35	0.03	0.32	Fused.
27932	*Waterbury*: The Mohican Co.	5	16	16.4	0.39	0.05	0.34	"
27933	Penn. Merchandise Co.	10	16	16.4	0.34	0.04	0.30	"
27934	Model Market Co	8	16	16.5	0.44	0.06	0.38	"
27936	Hewitt's Grocery	10	16	16.0	0.33	0.02	0.31	"

* Half pound. † "Natural Pure Food Head Rice, Uncoated," B. Fischer & Co., New York.

Dealer.	Price per lb. cts.	Weight claimed. oz.	Weight found. oz.	Ash Total.	Ash, Insoluble in HCl.	Ash, Soluble in HCl.	Appearance of Ash.
Bristol: L. G. Merick	10	16	16.0	0.44	0.10	0.34	Powdery.
Foucault & Roberge	10	16	17.7	0.47	0.13	0.34	"
Danbury: C. L. Morgan	8	16	16.0	0.52	0.18	0.34	"
Meriden: McBride & Co.	10	16	16.0	0.53	0.08	0.45	Partly fused.
Middletown: Village Store	8	16	16.0	0.47	0.16	0.31	Powdery.
Atlantic & Pacific Tea Co.	5	16	16.6	0.38	0.08	0.30	"
Middletown Cash Grocery	9	16	15.5	0.55	0.16	0.39	"
New Britain: Sovereign Trading Co.	10	16	15.8	0.40	0.08	0.32	"
Wray & Co.	5	16	16.0	0.55	0.14	0.41	"
Miller & Olson	10	16	16.1	0.64	0.21	0.43	"
*Great Western Market	7	16	15.1	0.47	0.03	0.44	Fused.
New Haven: Johnson & Bro.	10	16	19.9	0.43	0.06	0.37	Powdery.
E. Schoenberger & Sons	8	16	18.8	0.61	0.28	0.33	"
Wm. Hellar	6	16	16.2	0.40	0.12	0.28	"
New London: Mills Tea & Butter Co.	6	16	16.8	0.45	0.13	0.32	"
Norwich: A. Francis & Son	10	16	15.7	0.56	0.15	0.41	"
Waterbury: †Spencer Pierpont Co.	10	16	15.0	0.49	0.09	0.40	Partly fused.
F. J. Fabricant	10	16	16.2	0.83	0.40	0.43	Powdery.

* Short weight, not adulterated. † Also short weight.

Table XI.—Rice Sold as Compound.

Danbury: *Union Pacific Tea Co.	5	16	15.8	0.30	0.03	0.27	Fused.
†Village Store Co. (Pioneer Brand Choicest Head Rice.)	10	16	16.1	0.33	0.04	0.29	"
New Haven: †S. S. Adams. (Adams' Brand Selected Fancy Head Rice.)	10	16	16.1	0.34	0.03	0.31	"
New London: *Kiely's Tea Store. (Imperial Extra Fancy Domestic Rice, Japan Style, B. Fischer, N. Y.)	10	16	16.4	0.56	0.21	0.35	Powdery.
Waterbury: *T. S. Cruess. (White Swan Brand Fancy Head Rice, The R. N. FitzGerald Co., Hartford)	10	16	16.1	0.39	0.06	0.33	Fused.

both polished and unpolished rice. The appearance of the ash is also of value in judging as to the presence of talc. Unpolished rice gives a fused, glassy ash, while that of polished rice has a powdery appearance. A few of the samples passed by us as unpolished because of the fused appearance of the ash, contained suspiciously high percentages of total and insoluble ash.

Of the forty-four station samples, twenty-one were passed, seventeen contained talc or similar material, one was short-weight, and five were labeled as compound.

The samples not classed as adulterated ranged from 0.32 to 0.50 per cent. total ash, from 0.01 to 0.06 per cent. acid-insoluble ash, and from 0.28 to 0.46 per cent. acid-soluble ash. The samples found to contain talc ranged from 0.38 to 0.83 per cent. total ash, from 0.06 to 0.40 per cent. acid-insoluble ash, and from 0.30 to 0.44 per cent. acid-soluble ash. Only one of the five samples labeled as containing talc showed unmistakably that adulterant.

Samples **27958** and **27935**, sold respectively by Great Western Market, New Britain, and Spencer-Pierpont Co., Waterbury,

TABLE XII.—RICE.

(Sampled by Dairy Commissioner.)

	Dealer.	Ash. Total.	Ash. Insoluble in Hcl.	Ash. Soluble in Hcl.	Appearance of Ash
	Passed.				
6	*Bristol:* Foucault & Roberge........	0.38	0.04	0.34	Fused.
4	*Meriden:* McBride & Co.	0.36	0.05	0.31	"
1	*Middletown:* Bielfield & Thayer	0.44	0.08	0.36	"
3	Middletown Cash Grocery	0.37	0.03	0.34	"
9	*New Britain:* Sovereign Trading Co..	0.39	0.02	0.37	"
0	Great Western Market.	0.33	0.05	0.28	Mostly fused.
6	*New Haven:* Wm. Heller	0.44	0.05	0.39	Fused.
8	E. Schoenberger & Sons .	0.37	0.03	0.34	"
3	*Norwich:* A. Francis & Son.........	0.30	0.02	0.28	"
	Coated with Talc.				
7	*Bristol:* M. H. Smith...............	0.41	0.06	0.35	Powdery, slight fu
2	*Danbury:* C. L. Morgan............	0.72	0.29	0.43	Powdery.
2	*Middletown:* Atlantic & Pacific Tea Co.	0.66	0.29	0.37	"
8	*New Britain:* Wray & Co...........	1.03	0.55	0.48	"
1	Miller & Olson.......	0.45	0.08	0.37	"
9	*New Haven:* Johnson Bros.	0.37	0.06	0.31	Powdery and fuse
4	*New London:* Mills Tea and Butter Co.	0.50	0.09	0.41	Mostly fused
4	*Waterbury:* Spencer Pierpont Co.....	0.57	0.14	0.43	Powdery.
5	F. I. Fabricant..........	0.48	0.11	0.37	"

were decidedly short-weight, amounting to about one ounce in a pound.

The prices ranged from 5 to 10 cents per pound, the polished rice averaging about 0.5 cent higher per pound.

Entirely independent of the use of talc, the samples showed much variation in quality. Nos. **27796, 27802, 27969, 27900, 27902, 27694, 27932, 27934, 27643** and **27956** consisted very largely of broken or very small grains. Nos. **27815, 27940** and **27938** contained living insects.

Eighteen samples were taken by the Dairy Commissioner on our complaint. Nine of these were passed and nine were found to contain talc or similar material. The passed samples contained from 0.30 to 0.44 per cent. total ash, from 0.02 to 0.08 per cent. acid-insoluble ash, and from 0.28 to 0.39 per cent. of acid-soluble ash. The samples containing talc contained from 0.37 to 1.03 per cent. total ash, from 0.06 to 0.55 per cent. acid-insoluble ash and from 0.35 to 0.48 per cent. acid-soluble ash.

Nos. **6852, 6334** and **6328** consisted largely of broken grains, the latter also containing considerable dirt, which probably accounts in part for its abnormally high ash.

SAUSAGE.

In the analysis of samples of sausage for the dairy and food commissioner (see page 204), a useful method for the determination of starch was devised by Messrs. Bailey and Shepard, which consisted essentially of a combination of the well-known Mayrhofer and Sachsse methods. The following is a description of their experience with this method.

THE DETERMINATION OF STARCH IN MEAT PRODUCTS.

By E. M. Bailey and C. E. Shepard.

In the examination of meat and meat products for added starchy materials Mayrhofer's method is generally recommended for the determination of starch, and it is one of the provisional methods of the A. O. A. C. Upon applying this method in the course of an inspection of sausage, frankfurts, etc., we noticed that in Bur. of Chem., Bulletin 107 (revised), p. 110, l. 11, the sentence beginning "Acidify the filtrate . . ." is evidently intended to read "Acidify the solution . . ." After strongly acidifying the alkaline starch solution, making up to volume and filtering, an extremely slow filtration ensues and the filtrate

is very turbid. This turbidity is independent of the starch content of the sample under examination and is probably due to protein substances not entirely removed by the previous treatment. An abstract of Mayrhofer's paper in *The Analyst, 22,* 11 (1897) recommends to make the alkaline solution up to volume, filter and precipitate starch in an aliquot portion previously acidified with acetic acid. By this procedure the filtration is somewhat improved and the filtrate is reasonably clear.

For a number of reasons, however, we found the method unsatisfactory. Chief among these are the slow filtration of the alkaline starch solution, already mentioned, the time-consuming operation of filtering and washing the precipitated starch, and the use of tared papers. We therefore determined to try a modification of the method by directly hydrolyzing the starchy residue after the removal of protein and fat by the first filtration, then determining dextrose by copper reduction. This procedure is open to the criticism that any cellulose in the starchy residue is subjected to partial hydrolysis, but this objection has not proved serious enough to invalidate the method for the purpose at hand.

The complete procedure is as follows:

Mayrhofer-Sachsse Method for Starch in Meat Products. Treat 20 grams of the sample in a casserole with 50 c.c. of 8 per cent. solution of potassium hydroxide and digest on a steam bath with frequent stirring until the meat is entirely dissolved. Maintain the original volume approximately by the addition of water in case the solution appreciably concentrates. Add an equal volume of 95 per cent. alcohol, stir thoroughly and filter on a small Buchner funnel provided with a thin asbestos mat. Should the filter clog and filtration become slow, transfer the mat with residue to the casserole removing any adhering residue in the funnel by means of a wisp of moist asbestos. Prepare a new filter. Add warm 4 per cent. potassium hydroxide in 50 per cent. alcohol to the residue in the casserole, disintegrate the mass by stirring and pour upon the new filter. Wash twice with warm 4 per cent. alcoholic potash and finally with 50 per cent. alcohol. (A new mat is not always necessary, but on the whole it wastes no time as the second filtration is always rapid. Moreover, the starch becomes incorporated with the asbestos and is better acted upon in the hydrolysis.) Remove the filter to a 500 c.c. flask, add 200 c.c. of water, 20 c.c. of hydrochloric acid,—specific gravity 1.125—and hydrolyze in a boiling water bath for two and a half hours. Nearly neutralize with dilute sodium hydroxide, cool and make up to 500 c.c. Determine dextrose in 25 c.c. of the filtrate (equivalent to 1 gram of material) using Allihn's copper solution. Multiply the weight of dextrose by 0.9 to obtain the weight of starch.

This combination of the Mayrhofer and Sachsse methods was tried in a number of cases by determining the starch content in one portion of a sample and again in a duplicate portion to which a weighed amount of anhydrous starch had been added. The

sample was rendered as uniform as possible by hand mixing but this did not, in all cases, give as homogeneous a mixture as could be desired. The errors are somewhat increased by this factor.

The amounts of starch in the following table represent weights per gram of sample.

TABLE I.

	I.	II.	III.	IV.
Starch in sample, gm.	0.0010	0.0603	0.0019	0.0439
Starch added, gm.	0.0440	0.0440	0.0440	0.0440
Total starch present, gm.	0.0450	0.1043	0.0459	0.0879
Total starch found, gm.	0.0438	0.1073	0.0426	0.0836
Difference, in weight, gm.	—0.0012	+0.0030	—0.0033	—0.0043
" in per cent.	—0.12	+0.30	—0.33	—0.43

Taking into account the nature of the material worked upon, and remembering that the object of the determination is to distinguish between samples containing only spice starches and those containing added starchy materials, we believe that the results obtained are above reasonable criticism.

A comparison between the Mayrhofer method and the Mayrhofer-Sachsse method upon samples mixed as described is shown in the table below.

TABLE II.

Sample.	Mayrhofer Method.	Mayrhofer-Sachsse Method.	Difference by M.-S. Method.
6570	3.66%	3.96%	+0.30%
6571	4.68	4.86	+0.18
6573	1.09	1.24	+0.15
6574	0.50	0.31	—0.19
6575	3.18	2.73	—0.45
6577	0.30	0.20	—0.10
6578	2.25	2.02	—0.23
6580	2.09	2.13	+0.04
6581	0.38	0.40	+0.02

In addition to the determinations shown in Table II, 31 other determinations of starch in market samples were made, in duplicate, by the modified method. The percentages ranged from traces to 5.68 per cent. In only two cases was the variation between duplicates over 0.27 per cent., the average being 0.12 per cent. The method seems to meet all the requirements of a satisfactory working method at a saving in time of at least 50 per cent.

CANNED TOMATOES.

From the standpoint of output tomatoes are one of our most important canned vegetables. They naturally contain so much water in their tissues, that, unlike many other vegetables, such as corn and peas, it is unnecessary to add any water to them during the canning process. Such an addition is not only unnecessary, but has also been ruled as an adulteration by the U. S. government. (Food Inspection Decision 144.)

Tomatoes are filled into the cans either by hand or by machine. The cans filled full of whole tomatoes by hand are known as "hand-packed" or "solid packed," as distinguished from those filled by machine, or filled with a mixture of whole tomatoes and added juice. In machine-packed tomatoes the fruit is naturally more or less broken, thus affecting the appearance, but not the quality, of the product.

Tomatoes are sold under different grades, such as extra choice, extra select, choice, select, extra standard, standard and seconds. In many cases these prefixes are meaningless. The "extra choice" of one packer may be no better than the "standard" of another. The packer's name at the present time is more of a criterion as to quality than the grade specified. As Bitting says:*

"There should be but two grades—selected or first grade, and standard or field run for the second. A can of first grade tomatoes should be from selected, prime, ripe fruit, having a fleshy body, well-developed flavor and uniform color. The can when opened should be full and most of the tomatoes whole or in large pieces, free from all peel, core, or defects. The net weight should not be less than 32 ounces in a No. 3 can. A can of standard tomatoes should be from sound, ripe fruit, having a fair body and good flavor. The can when opened should be full, and part of the tomatoes whole or in large pieces. They should be well peeled and cored. The net contents of a No. 3 can should not weigh less than 32 ounces."

Tomatoes are generally packed in No. 3 cans for household trade. This can may be of the regular size or what is known as "extra tall."

In judging canned tomatoes there must be considered the appearance, ripeness and quality of the fruit, the relative amounts of pulp and juice, and the amount, if any, of added water. Furthermore, it must be determined whether the original fruit

* Bur. of Chem., Bull. *151*, page 61.

consisted of sound material, or whether spoiled or partially spoiled stock had been used. Bacon and Dunbar have pointed out * that

"When tomatoes spoil as a result of the life processes of bacteria, yeasts, and molds, the sugars are rapidly used up, being changed principally into acetic acid, lactic acid, alcohol and carbon dioxid, the amounts *of these substances depending on the types of organisms which are most* active in the particular sample in question. During most classes of spoilage the citric acid is also rapidly decomposed, so that its amount serves as a valuable index in detecting decomposition. It is very easy to detect spoilage in tomato pulp or canned tomatoes, as such products, *when perfectly sound, contain no volatile* acids and a *considerable* percentage of citric acid and invert sugar, and when spoiled quite large amounts of volatile acids are present with little or no invert sugar or citric acid."

Forty-one samples of canned tomatoes were examined, the brand names and packers of which are given in full in Table XIII.

TABLE XIII.—BRANDS.

27994. Whole Tomatoes. Oneida Community Limited, Oneida, N. Y.

27993. Highest Grade Tomatoes. Montclair Jam Kitchens, Montclair, N. J.

27954. Bay Ridge Brand Finest Quality Tomatoes. J. W. Bay & Co., Lincoln City, Del.

27926. Burt Olney's Solid Packed Selected Tomatoes. The Burt Olney Canning Co., Oneida, N. Y.

27991. Butter-Nut Brand Hand Packed Tomatoes Fancy Quality. Fredonia Preserving Co., New York.

27964. Golden Rose Brand Fancy Tomatoes. Seeman Bros., New York (Dist.).

27904. Golden Tip Brand Hand Packed Tomatoes Extra Selected. A. J. Tanner Co., Oakfield, N. Y.

27927. Locust Point Brand Hand Packed Tomatoes First Quality. Oriole Packing Co., Oriole, Md.

27897. Our Cook's Brand Tomatoes Fancy Quality. R. C. Williams & Co., New York (Dist.).

27891. Sunbeam Pure Food Hand Packed Tomatoes. Austin, Nichols & Co., New York (Dist.).

27892. Arlington Brand Selected Tomatoes. Austin, Nichols & Co., New York (Dist.).

27607. Orion Brand Red Ripe Tomatoes Selected Quality. Acker, Merrall & Condit Co., New York (Packed for).

27930. Oakland Brand Tomatoes Extra Quality. Granger & Co., Buffalo, N. Y. (Packed for)

* Bur. of Chem., Circ. 78.

27690. Abbsco Brand Tomatoes First Quality. Jas. Wallace Packing Co., Cambridge, Md.

27899. Empire Tomatoes First Quality. Winters & Prophet Canning Co., Mount Morris, N. Y.

27691. Optimus Brand Tomatoes First Quality. Waddington & Holme, Naylors, Va.

27824. Our New Century Tomatoes First Quality. (Monogram) "B.R.P.C."

27963. Rosehill Brand Tomatoes First Quality. Charles Webster, East Newmarket, Md.

27992. Adieno Brand Tomatoes Choice Quality. Clark, Chapin & Bushnell, New York (Packed for).

27917. Whitby's Choice Tomatoes. C. H. Whitby & Son, Denton, Md.

27609. Bob White Brand Tomatoes, Standard Tomatoes. Albert Webb & Son, Vienna, Md.

27689. Ames' Quality Brand Tomatoes. S. K. Ames, Boston (Dist.).

27965. Antler Brand Tomatoes. Tucker & Goodwin, Hartford (Packed for).

27907. Bon Ton Brand Tomatoes. The R. N. Fitzgerald Co., Hartford (Packed for).

27645. Broad Creek Brand Tomatoes. E. C. Ross, Seaford, Del.

27950. Cirio's Peeled Tomatoes. Societá Generale delle Conserve Alimentari Cirio, S. Giovanni a Teduccio, Presso, Napoli, Italy.

27608. Glenmore Brand Tomatoes. The John Boyle Co., Baltimore, Md.

27928. Golden Rule Brand Tomatoes. Phillips Packing Co., Cambridge, Md.

27915. Guilford Tomatoes. Sachem's Head Canning Co., Guilford.

27794. Hazel Dell Brand Tomatoes. J. W. Bay & Co., Lincoln City, Del.

27797. Lake Erie Brand Tomatoes. Silver Creek Pressing Co., Silver Creek, N. Y.

27990. Maryland Special Brand Tomatoes. Phillips Packing Co., Cambridge, Md.

27807, 27953. M. and W. Brand Tomatoes. James T. Wilson & Co., Delmar, Del.

27678. Nabob Tomatoes. Francis H. Leggett & Co., New York (Dist.).

27962. Polo Brand Tomatoes. Stoddard, Gilbert & Co., New Haven (Packed for).

27823. Pride of Somerset Tomatoes. Arden Packing Co., Arden, Md.

27677. Red Bird Tomatoes. T. H. Chambers & Co., Federalsburg, Md.

27929. Richelieu Brand Tomatoes. Sprague, Warner & Co., Chicago (Dist.).

27989. St. Lawrence Brand Tomatoes. The Medina Canning Co., Medina, N. Y.

27946. Triangle Brand Tomatoes. Hoffecker Bros. & Hall, Smyrna Landing, Del.

Twenty-one samples claimed a special quality, ranging from "whole" to "standard." Two samples came in No. 2 cans, 27 in *No. 3, 8 in No. 3, 5 in. Jersey, 1 in No. 3, 5.5 in. Jersey, 1 in an odd size (3½ x 3 11-16), and 2 in glass jars. The following is* a summary of the net weight of contents in the various sized containers:—

No. of Samples.	Size of Can.	Net Weight of Contents. Max. gms.	Min. gms.	Ave. gms.
2	No. 2	584	579	582
27	No. 3	1003	879	940
8	No. 3, 5 in.	1056	987	1022
1	No. 3, 5.5 in.	—	—	1159
1	odd	—	—	497
2	jars	905	876	891

Accepting Bitting's figure of 32 ozs. (= 907 gms.) as a standard for No. 3 tomatoes, only one sample, **27927**, can be considered as short fill, containing 880 gms., or 31 ozs.

It is apparent, however, that net weight of contents considered by itself has little direct value, as this weight may be due to tomatoes, water, or a mixture of the two.

All the samples were separated, therefore, into pulp and juice, by straining through cheese cloth (40 threads to the inch) allowing the fruit to drain, without crushing, as long as the juice dropped freely. Such a method, of course, gives somewhat too high values for pulp and too low for juice. Too much importance may be given to the amount of pulp separated by this method. A high percentage of pulp may be secured by the use of hard, slightly green fruit. On the other hand a thoroughly ripe tomato, *which alone has the full flavor of the fruit, may through its* ripeness be more or less disintegrated during processing, or may be badly broken after a long shipment. The relative amounts of pulp and juice must, therefore, be considered with much care in order to reach a proper judgment. The Ohio Trade Standard for "fancy" tomatoes requires a minimum of 20 ozs. of fruit exclusive of juice, and for "standard" tomatoes a minimum of 18 ozs., both in No. 3 cans, containing about 32 ozs. net weight.

No. 3 is the standard size for tomatoes, and two-thirds of our samples are of that size. In these samples the pulp ranged from 264 to 541 gms., the juice from 408 to 682 gms., and the per cent.

of juice from 43 to 72. Eleven of the samples claimed superior quality, and none of these contained the minimum of 20 ozs. of fruit required by the Ohio Standard, ranging as they did from 11.7 to 15.5 ozs., and the percentage of juice from 54 to 64 per cent. Only three of the twenty-seven samples exceeded or approximated the minimum of 18 ozs. for "standard" tomatoes. Expressing these results in a different way, of the samples in No. 3 cans, 3 contained from 9.3 to 12 ozs. of drained pulp, 17 from 12.1 to 15 ozs., 4 from 15.1 to 18 ozs., and 2 from 18.1 to 19.1 ozs. Of the same samples 4 contained from 43 to 50 per cent. of juice, 15 from 52 to 60, 6 from 61 to 64 and 2 over 70.

Considering the samples as a whole, excluding **27891** and **27824** which were in No. 2 cans, and **27950**, an odd size, we find the drained pulp ranged from 264 to 698 gms., the juice from 405 to 682 gms., and the percentage of juice from 40 to 72 per cent. Only seven samples contained over 18 ozs. of fruit. It is apparent that the great majority of the brands examined contained excessive juice, and that the addition of water is a very common practice. The amount of added water will be considered later on in this report.

The character of the fruit showed considerable variation. In eight samples practically whole tomatoes were found; in twenty-five, large lumps, in four, small lumps, while in four a mushy consistency was observed. As regards ripeness, thirty-one samples were of excellent quality, while ten contained more or less wholly or slightly green pieces. Sample **27990** is quite striking from the fact that it contained a very high percentage of juice, 71 per cent., and only 9.5 ozs. of fruit, and that this small amount of fruit present was not ripe.

Excluding the two samples sold in glass and intended for fancy trade, and the three samples in odd sizes, the cost per can ranged from 9 to 15 cents. The cost per pound of dry matter ranged from 75 cents to $1.86, and the cost per pound of tomatoes of average water content from 4.8 cents to 11.9 cents. In the samples packed in glass the cost per pound of dry matter was $2.45 and $3.61. A study of the table shows that quality was not the sole consideration in determining cost, and that in many cases the consumer paid a high price for added water.

TABLE XIV.

Station No.	Brand.	Quality claimed.	Weight of			
			Can and Contents.	Pulp and Juice.	Drained Pulp.	
			gms.	gms.	gms.	g
27994	Oneida Community...	Whole	1520	876	476	4
27993	Montclair Jam Kitchens...............	Highest Grade............	1514	905	407	4
27954	Bay Ridge...........	Finest Quality.............	1064	927	377	5
27926	Burt Olney	Solid Packed Selected......	1178	1023*	454	5
27991	Butter-nut............	Hand Packed Fancy Quality.	1220	1056	556	5
27964	Golden Rose.........	Fancy	1160	1003	430	5
27904	Golden Tip..	Hand Packed Extra Selected.	1163	1012	607	4
27927	Locust Point.........	Hand Packed First Quality.	1017	880	367	5
27897	*Our Cook's*..........	*Fancy Quality*.............	*1087*	*936*	*380*	5
27891	Sunbeam Pure Food..	Hand Packed..............	691	584	333	2
27892	Arlington............	Selected..................	1177	1035	538	4
27607	Orion................	Red Ripe Selected..........	1067	927	332	5
27930	Oakland	Extra Quality.............	1086	937	428	5
27690	Abbsco..............	First Quality..............	1049	911	353	5
27899	Empire	" "	1161	1008	483	5
27691	Optimus.............	" "	1022	879	439	4
27824	Our New Century....	" "	680	579	296	2
27963	Rosehill	" "	1091	956	385	5
27992	Adieno..............	Choice Quality............	1087	943	349	5
27917	Whitby's	Choice	1093	952	409	5
27609	Bob White...........	Standard..................	1095	946	264	6
27689	Ames' Quality.......	....	1102	961	500	4
27965	Antler..............	....	1103	958	368	5
27907	Bon Ton.............	....	1080	941	408	5
27645	Broad Creek.........	....	1028	894	372	5
27950	Cirio's..............	Peeled....................	606	497	227	2
27608	Glenmore...........	....	1078	945	457	4
27928	Golden Rule.........	....	1045	911	389	5
27915	Guilford.............	....	1212	1055	562	4
27794	Hazel Dell..........	....	1079	941	411	5
27797	Lake Erie...........	....	1081	949	541	4
27990	Maryland Special.....	....	1061	924	270	6
27807	M. and W...........	....	1122	988	384	6
27953	" "	....	1096	957	350	6
27678	Nabob	....	1321	1159	698	4
27962	Polo................	....	1055	921	385	5
27823	Pride of Somerset....	....	1098	960	412	5
27677	Red Bird...........	....	1097	960	423	5
27929	Richelieu	....	1122	971†	530	4
27989	St. Lawrence........	....	1155	987*	417	5
27946	Triangle	....	1161	998	367	6

**Claimed net wgt., 33 oz. = 936 gms.* †*Claimed net wgt. 34 oz. = 964 gms*

ANNED TOMATOES.

Per cent. Juice.	Nature of Tomatoes.	Ripeness.	Cost per Can.	Cost per lb. of Dry Matter.	Cost per lb. of Average Tomatoes.
			cts.	cts.	cts.
46	Whole.	O. K.	30	245	15.7
55	Some whole; large pieces.	"	35	361	23.1
59	Lumps.	Some green pieces.	13	139	8.9
56	Lumps.	O. K.	15	88	5.6
47	Some whole; large pieces.	"	15	91	5.8
57	Lumps.	"	13	120	7.7
40	Whole.	"	12	97	6.2
58	Lumps.	"	12	127	8.1
60	"	"	15	121	7.7
43	Some whole; large pieces.	"	10	158	10.1
48	Large lumps.	1 nearly green; rest O.K.	13	110	7.0
64	Lumps.	O. K.	10	108	6.9
54	"	Partly green.	10	75	4.8
61	"	Few green pieces.	10	139	8.9
52	"	Slightly green.	15	108	6.9
50	"	O. K.	10	89	5.7
49	"	"	8	120	7.7
60	Large lumps.	Slightly green.	10	106	6.8
63	One whole; large pieces.	O. K.	15	186	11.9
57	Small lumps.	"	9	78	5.0
72	Lumps.	"	10	156	10.0
48	"	Few green pieces.	10	99	6.3
62	Small lumps.	O. K.	12	108	6.9
56	Lumps.	"	10	107	6.8
58	"	"	12	176	11.3
54	Mushy.	"	12	174	11.1
52	Large lumps.	"	12	149	9.5
57	Lumps.	"	10	132	8.5
47	Some whole, large pieces.	"	13	120	7.7
56	Mushy.	"	10	79	5.1
43	Lumps.	"	11	108	6.9
71	Mushy.	Slightly green.	12	186	11.9
52	Lumps.	O. K.	9	90	5.8
63	Large lumps.	"	9	96	6.1
40	Small lumps.	Very ripe.	15	112	7.2
58	Lumps.	O. K.	13	152	9.7
59	"	Some green pieces.	12	124	7.9
56	Small lumps.	Very ripe.	13	140	9.0
45	Some whole; large pieces.	O. K.	15	127	8.1
58	Lumps; mushy.	One green.	12	69	4.4
53	Lumps.	O. K.	10	73	4.7

TABLE XV.

Brand.	Water.	Solids.	Salt-free Ash.	Salt (NaCl).	
Oneida Community	93.66	6.34	0.444	0.249	3.
Montclair Jam Kitchens	95.12	4.88	0.422	0.550	1.
Bay Ridge	95.42	4.58	0.340	0.045	1.
Burt Olney	92.43	7.57	0.432	0.482	3.
Butter-Nut	92.94	7.06	0.390	0.630	3.
Golden Rose	95.11	4.89	0.400	0.186	2.
Golden Tip	94.46	5.54	0.348	0.121	2.
Locust Point	95.11	4.89	0.418	0.060	2.
Our Cook's	93.98	6.02	0.484	0.434	2.
Sunbeam Pure Food	95.09	4.91	0.374	0.236	2.
Arlington	94.80	5.20	0.483	0.065	2.
Orion	95.48	4.52	0.401	0.055	2.
Oakland	93.55	6.45	0.441	0.479	2.
Abbsco	96.42	3.58	0.277	0.051	1.
Empire	93.77	6.23	0.490	0.889	2.
Optimus	94.08	5.92	0.442	0.055	3.
Our New Century	94.79	5.21	0.519	0.077	2.
Rosehill	95.51	4.49	0.391	0.048	1.
Adieno	96.13	3.87	0.424	0.058	1.
Whitby's	94.53	5.47	0.463	0.057	2.
Bob White	96.98	3.02	0.270	0.033	1.
Ames' Quality	95.26	4.74	0.394	0.057	1.
Antler	94.75	5.25	0.524	0.040	2.
Bon Ton	95.49	4.51	0.389	0.052	1.
Broad Creek	96.56	3.44	0.347	0.059	1.
Cirio's	93.71	6.29	0.496	0.060	2.
Glenmore	96.14	3.86	0.333	0.036	1.
Golden Rule	96.22	3.78	0.280	0.039	2.
Guilford	95.36	4.64	0.343	0.196	2.
Hazel Dell	93.87	6.13	0.393	0.047	3.
Lake Erie	95.12	4.88	0.435	0.056	2.
Maryland Special	96.83	3.17	0.312	0.144	1.
M. and W.	95.40	4.60	0.443	0.069	2.
M. and W.	95.58	4.42	0.358	0.055	1.
Nabob	94.74	5.26	0.437	0.038	2.
Polo	95.78	4.22	0.449	0.051	1.
Pride of Somerset	95.40	4.60	0.520	0.056	2.
Red Bird	95.63	4.37	0.386	0.046	1.
Richelieu	94.48	5.52	0.486	0.038	2.
St. Lawrence	92.02	7.98	0.368	1.136	3.
Triangle	93.76	6.24	0.416	0.087	2.
Maximum	*96.98*	*7.98*	*0.524*	*1.136*	*3.*
Minimum	*92.02*	*3.02*	*0.270*	*0.033*	*1.*
Average	*94.91*	*5.09*	*0.409*	*0.176*	*2.*

NNED *TOMATOES.*

	Ammonia by Magnesium Oxide.	Acidity in cc. $\frac{N}{10}$ Na OH per 100 gms. Total.	Acidity: Volatile.	Citric Acid (Anhydrous): Determined.	Citric Acid (Anhydrous): Calculated from total acidity.	Specific gravity of juice at 25° C.	In Dry Matter: Salt-free Ash.	In Dry Matter: Salt (NaCl).	In Dry Matter: Sugar, as Invert.	In Dry Matter: Citric Acid (Anhydrous.)
96	0.011	52.0	2.4	0.46	0.36	1.0195	7.00	3.93	53.31	7.26
43	0.018	45.2	2.0	0.37	0.32	1.0140	8.65	11.27	29.71	7.58
60	0.022	44.8	1.6	0.31	0.31	1.0130	7.42	0.98	43.23	6.77
63	0.024	72.0	2.4	0.56	0.50	1.0270	5.71	6.37	52.05	7.40
97	0.026	44.0	2.8	0.28	0.31	1.0215	5.52	8.92	43.77	3.97
75	0.020	47.8	2.8	0.36	0.33	1.0160	8.18	3.80	43.76	7.36
92	0.021	54.0	2.6	0.39	0.38	1.0207	6.28	2.18	47.44	7.04
75	0.024	52.8	2.0	0.42	0.37	1.0160	8.55	1.23	43.76	8.59
41	0.014	50.0	1.6	0.37	0.35	1.0238	8.04	7.21	43.36	6.15
68	0.025	47.2	1.4	0.27	0.33	1.0198	7.62	4.81	45.42	5.50
75	0.019	60.4	1.0	0.43	0.42	1.0207	9.28	1.25	47.12	8.26
49	0.022	63.0	1.4	0.42	0.44	1.0122	8.87	1.22	44.91	9.29
33	0.022	66.8	1.6	0.59	0.47	1.0200	6.84	7.43	40.62	9.15
17	0.022	46.4	1.8	0.32	0.32	1.0126	7.74	1.42	39.39	8.94
04	0.014	53.6	1.6	0.46	0.38	1.0252	7.87	14.27	35.15	7.38
52	0.016	56.8	2.0	0.40	0.40	1.0224	7.47	0.93	57.43	6.76
80	0.016	49.2	2.2	0.41	0.34	1.0206	9.96	1.48	46.26	7.87
89	0.027	55.2	4.0	0.41	0.39	1.0130	8.71	1.07	35.63	9.13
72	0.024	53.8	2.6	0.44	0.38	1.0110	10.96	1.50	29.72	11.37
95	0.024	60.6	2.4	0.50	0.42	1.0220	8.46	1.04	46.07	9.14
78	0.012	37.8	3.0	0.22	0.26	1.0103	8.94	1.09	41.06	7.28
96	0.021	47.8	2.2	0.33	0.33	1.0160	8.31	1.20	37.55	6.96
10	0.021	51.6	2.4	0.42	0.36	1.0165	10.00	0.76	40.95	8.00
33	0.025	71.0	3.6	0.44	0.50	1.0170	8.63	1.15	37.25	10.00
05	0.019	46.8	2.8	0.29	0.33	1.0130	10.09	1.71	40.41	8.43
39	0.009	54.0	1.8	0.47	0.38	1.0170	7.89	0.95	46.10	7.47
07	0.010	43.8	2.6	0.30	0.31	1.0138	8.63	0.93	46.37	7.78
74	0.013	27.6	2.0	0.20	0.19	1.0120	7.41	1.03	53.97	5.29
51	0.020	64.0	3.2	0.52	0.45	1.0190	7.39	4.22	43.75	11.21
52	0.018	48.6	2.8	0.29	0.34	1.0226	6.41	0.77	58.89	4.73
50	0.018	55.2	5.0	0.43	0.39	1.0187	8.91	1.15	48.77	8.81
15	0.021	38.0	1.6	0.30	0.27	1.0100	9.84	4.54	32.18	9.46
58	0.024	65.2	3.0	0.44	0.46	1.0190	9.63	1.50	43.91	9.57
19	0.021	56.8	1.8	0.45	0.40	1.0175	8.10	1.24	43.67	10.18
50	0.012	47.6	2.8	0.41	0.33	1.0188	8.31	0.72	50.57	7.79
48	0.022	57.4	4.8	0.42	0.40	1.0150	10.64	1.14	41.23	9.95
46	0.018	58.8	2.0	0.40	0.41	1.0183	11.30	1.22	46.52	8.70
48	0.022	53.4	2.8	0.33	0.37	1.0166	8.83	1.05	43.25	7.55
27	0.027	68.0	2.0	0.53	0.48	1.0170	8.80	0.69	40.76	9.60
02	0.028	53.6	2.0	0.39	0.38	1.0290	4.61	14.24	49.62	4.89
46	0.017	54.0	2.4	0.35	0.38	1.0170	6.67	1.39	44.55	5.61
04	*0.028*	*72.0*	*5.0*	*0.59*	*0.50*	*1.0290*	*11.30*	*14.27*	*58.89*	*11.37*
74	*0.009*	*27.6*	*1.0*	*0.20*	*0.19*	*1.0100*	*4.61*	*0.72*	*29.71*	*3.97*
83	*0.020*	*53.1*	*2.4*	*0.40*	*0.37*	*1.0177*	*8.26*	*3.73*	*43.90*	*7.91*

Chemical Composition.

The average composition of 66 samples of tomatoes as given in Experiment Station Work, 1903, and the average composition of canned tomatoes as given by Wiley, Foods and their Adulteration, 1907, p. 315, are as follows:—

	Whole Tomatoes.	Canned Tomatoes.
Water	93.64	93.59
Fat	0.43	0.23
Fiber	0.75	0.60
Starch and Sugar	3.80	3.47
Sugar	3.05	—
Protein (N × 6.25)	0.91	1.29
Ash (NaCl free)	0.47	0.52
Salt	—	0.14
Citric Acid	0.48	—

The important determinations in judging the quality of canned tomatoes are solids, salt-free ash, sugar, citric acid, ammonia, volatile acid and specific gravity of the juice.

Solids. The solids ranged from 3.02 to 7.98, average, 5.09 per cent.; 7 samples contained under 4 per cent., 16 from 4 to 5, 8 from 5 to 6, and 10 over 6 per cent. Any sample containing less than 5 per cent. of solids must be suspected of containing added water; 23, or over half, of the samples fall under this suspicion.

Sugar. Invert sugar ranged from 1.02 to 3.96, average, 2.26 per cent. A deficiency in sugar might arise from under-ripe fruit, from added water or from spoilage. Other data failed to indicate spoilage in any of the samples, so we may dismiss that cause from consideration at this time. While in a few instances slightly green or under-ripe fruit was associated with a relatively low sugar content, unripeness in no case appeared to be the determining cause for the deficiency in sugar. It would seem, therefore, that chiefly added water influenced the sugar content. Fourteen samples contained from 1 to 2 per cent., 21 from 2 to 3 per cent., and only 6 over 3 per cent. The amounts of sugar contained in tomatoes of different varieties and of varying degrees of ripeness are far from constant. A consideration of the sugar-free solids, therefore, affords a better basis to work on.

Sugar-free Solids. The sugar-free solids ranged from 1.74 to 4.04, average, 2.83 per cent. Eleven samples contained from 1.7

than 3 per cent. of sugar-free solids justifies a suspicion as to added water.

Salt-free Ash. The salt-free ash ranged from 0.270 to 0.524, average, 0.409 per cent. Twelve samples contained from 0.27 to 0.37, 21 from 0.38 to 0.47, and 8 over 0.47 per cent. Less than 0.40 per cent. would indicate added water, and less than 0.50 per cent. excite a strong suspicion as to its presence.

Salt. The salt ranged from 0.033 to 1.136, average, 0.176 per cent. Twenty-nine samples contained under 0.14 per cent., 8 from 0.14 to 0.50, and 4 over 0.50 per cent. In the last four samples the salt made up from 57 to 75 per cent. of the ash, seemingly an excessive quantity.

Citric Acid. Citric acid was determined directly in all the samples, and also calculated from the total acidity as determined by tenth-normal alkali. The determined values averaged 0.03 per cent. higher than the calculated. Citric acid ranged from 0.20 to 0.59, average, 0.40 per cent. Twelve samples contained less than 0.35 per cent., 6 from 0.35 to 0.40, 18 from 0.40 to 0.50, and 5 over 0.50 per cent. A low percentage of citric acid might be due to spoilage or to added water, but as already stated no evidence of spoilage was detected. Less than 0.35 per cent. of citric acid renders a strong suspicion of added water.

Volatile Acid. Volatile acid, as acetic, ranged from 0.006 to 0.030, the latter figure alone suggesting any marked amount of spoilage. In this sample the citric acid was nearly normal and the sugar only slightly below standard. There was, therefore, no evidence of any marked acetic acid fermentation in the samples.

Ammonia. The percentages of ammonia found tend also to the same conclusion. They ranged from 0.009 to 0.028 per cent., in no case significant.

Specific Gravity of Juice. This ranged from 1.0100 to 1.0290, average, 1.0177. While this determination is influenced to an important degree by added salt and by sugar which may have been natural to the fruit or directly added, it is significant that the seven samples with the lowest percentages of solids showed juice specific gravities ranging from 1.0100 to 1.0138, only one other sample showing as low as 1.0122, and only two as low as 1.0130.

Per Cent. of Sugar in Salt-free Solids. It was hoped that this determination might give some added data as to the ripeness of

the tomatoes, but the variations in sugar content due to varietal differences, climatic influences, and the possible addition of sugars during the canning process, render their use of uncertain value. These percentages ranged from 30.2 to 59.4, average, 45.4.

Added Water. From our knowledge of the composition of the tomato fruit and of the process of canning tomatoes, we regard any sample as suspicious which contains less than 5 per cent. of solids, less than 3 per cent. of sugar-free solids, less than 0.35 per cent. of citric acid, and less than 0.5 per cent. of salt-free ash. Any sample containing less than 3 per cent. of sugar-free solids, less than 0.35 per cent. of citric acid or less than 0.4 per cent. of salt-free ash, we would condemn as containing added water. Based on these limits our samples may be grouped into three classes, 15 which we pass as genuine, 17 which we consider as suspicious, and 9 whose chemical composition indicates added water. The tabulation below shows the maximum, minimum and average figures obtained in each of these classes.

	Solids.	Sugar-free Solids.	Citric Acid.	Salt-free Ash.
Passed.				
Maximum	7.98	4.04	0.59	0.52
Minimum	4.88	2.75	0.28	0.42
Average	**6.11**	**3.40**	**0.44**	**0.46**
Suspicious.				
Maximum	6.13	2.96	0.52	0.52
Minimum	4.22	2.46	0.29	0.34
Average	**4.90**	**2.66**	**0.33**	**0.40**
Condemned.				
Maximum	4.37	2.72	0.45	0.42
Minimum	3.02	1.74	0.20	0.27
Average	**3.72**	**2.18**	**0.32**	**0.33**

The nine samples condemned as containing added water were Nos. **27608, 27609, 27645, 27677, 27690, 27928, 27953, 27990** and **27992.** None of these is condemned for shortage in one ingredient only. These certainly contain added water, and it is reasonably certain that some of those included in the suspicious class also contain added water, but from the data at hand we do not feel justified in condemning them. Six of these were packed in Maryland and two in Delaware.

NET WEIGHT OF VARIOUS PACKAGE GOODS.

In Bulletin 172 of this station were published the results of an investigation of the variations in net weight of certain classes of foods sold in package form. Brand names were not given in the bulletin, but they are published now for the guidance of the consumer. The detailed discussion of the bulletin will not be repeated here, attention being called only to those brands which showed a tendency towards short weight.

About 2,000 packages were weighed, representing 150 brands of about 75 kinds of foods.

A definite weight was claimed on 594 of the packages examined. Five hundred and seventeen of these either exceeded the claimed weight or were deficient by less than 0.25 oz. Of the 77 deficient samples the deficiency in 20 samples appeared to be exceptional, 102 samples of the same brands fully satisfying their claims. The remaining 57 samples, however, showed a general tendency towards short weight.

Samples Showing Short Weight.

The following brands showed the greatest deficiencies:

Potted Meat Beef Ham Flavor, Libby, McNeill & Libby, Halves. All 12 samples were deficient by from 1.0 to 1.4 ozs.

Medium Egg Macaroni, Freihofer. Ten of 12 samples were deficient by from 0.7 to 2.6 ozs.

Egg Elbow Macaroni, Freihofer. Eleven of 12 samples were deficient by from 0.4 to 1.3 ozs.

Egg Elbow Spaghetti, Gold Leaf, Freihofer. Eight of 12 samples were deficient by from 0.4 to 1.4 ozs.

Educator Toasterettes, Johnson. Ten of 12 samples were deficient by from 0.3 to 1.2 ozs.

Frotana, Nat. Biscuit Co. Four of 12 samples were deficient by from 0.3 to 0.8 oz.

Kellogg's Toasted Corn Flakes. Six of 12 samples were deficient by from 0.4 to 1.8 ozs.

Relative Amounts of Solids and Liquor in Canned Goods.

A statement of net weight may be misleading if quality is not considered as well. The addition of water to canned vegetables,

fruits or fish might bring the net weight up to a normal figure, which would give but little information, however, as to the relative amount of food present. To illustrate this point duplicate samples of thirty brands of foods were separated into solid and liquid portions by draining through a sieve. The results were discussed in detail in Bulletin 172, and will not be repeated here. Attention is called, however, to the foot notes to Table XVI, in which these data are given in connection with the specific brands. Additional data will be found in our Report for 1910, page 462, and under tomatoes in this report.

The Cost of Package Goods.

Table XVI shows the cost per package and the cost per pound of the different foods. All these prices, with the exception of those for crackers and biscuit, represent prices based on dozen lots and probably were the most favorable prices obtainable by the purchaser in New Haven in April of this year. Granting that quality should have an important effect on price, these prices reveal, or rather emphasize, some important facts. For instance, Standard String Beans and Compass Brand String Beans both cost 7.5 cents per can of about equal capacity; the former, however, contained 58 per cent. of liquor compared with 50 per cent. in the latter. This comparison is even more striking when we consider the Magnes Refugee Beans which cost two cents more per can and yet contain only 38 per cent. of liquor. Similarly with tomatoes, the Butter-Nut Hand Packed cost 9.5 cents per No. 2 can, or 7.8 cents per pound of canned tomatoes, while the Maryland Special cost 11 cents per No. 3 can, or 5.6 per pound. While at first glance the latter brand seems the cheaper purchase, our analysis shows it to contain 71 per cent. of juice, while the Butter-Nut contains only 47 per cent. In the smaller can of the Butter-Nut, therefore, the purchaser would obtain 10.3 ozs. of drained tomatoes for two cents a can less than he would obtain in the larger can of Maryland Special, containing only 9.5 ozs. of drained tomatoes.

Again, the Jumbo Pie Peaches contained 32.4 ozs. of fruit and liquor per can, at a cost of 10.5 cents, while the Yellow Free Peaches contained 30.5 ozs. at 19 cents. These data apparently favor the Jumbo as much the cheaper purchase. When we con-

TABLE XVI.—NET WEIGHT OF VARIOUS PACKAGE GOODS.

Brand and Manufacturer.	No. Packages weighed.	Net Weight. Maximum.	Minimum.	Average.	Cost per Package.	Average cost
		oz.	oz.	oz.	cts.	ct:
Vegetables.						
Asparagus.						
Monte Brand Colossal Green. Cal. Fruit Canners sso., San Francisco	24	32.2	30.7	[1]31.6	23	II.
Monte Brand Green Tips. Cal. Fruit Canners sso., San Francisco	24	16.8	16.0	[2]16.4	20	19.
Artichokes.						
:rtas Brand. Fratelli Mustica, Palermo, Italy	12	24.4	22.3	[3]23.6	12	8.
Beans.						
;nes Red Kidney. Fredonia Pres. Co., Fredonia, . Y	24	22.0	20.7	[4]21.3	8	6.
;nes Ripe Lima. Fredonia Pres. Co., Fredonia, . Y	24	21.6	20.7	[5]21.3	9.5	7.
.dard String. Gibbs Pres. Co., Baltimore, Md	24	19.3	18.6	[6]19.0	7.5	6.
ıpass Brand String. D. E. Foote and Co., Baltiore, Md	12	20.0	18.5	[7]19.4	7.5	6.
:er-Nut Fancy Refugee. Fredonia Pres. Co., Fre›nia, N. Y	24	20.8	19.9	[8]20.3	13.5	10.
nes Refugee. Fredonia Pres. Co., Fredonia, N. Y.	24	20.8	20.5	[9]20.7	9.5	7.
:nes Yellow Wax. Fredonia Pres. Co., Fredonia, . Y	24	21.0	20.5	[10]20.8	8	6.
:er-Nut Golden Wax. Fredonia Pres. Co., Fre›nia, N. Y	24	20.8	20.6	[11]20.7	12	9.
Beans and Pork.						
Camp's with Tomato Sauce. Van Camp Pack. ›., Indianapolis	18	22.5	21.8	[12]22.1	8	5.
er's with Tomato Sauce, T. A. Snider Pres. Co., ncinnati	12	22.8	22.0	[12]22.4	12	8.
Beets.						
:er-Nut Cherry. Fredonia Pres. Co., Fredonia, . Y	24	21.6	20.3	[13]21.2	10	7.
Corn.						
nes Sweet. Fredonia Pres. Co., Fredonia, N. Y.	24	21.8	21.1	21.4	8	6.
:hern Queen Sweet Sugar. F. C. Bushnell Co., ew Haven	24	20.9	20.6	20.8	7.5	5.
er-Nut Maine Fancy. Fredonia Pres. Co., Fre›nia, N. Y	24	20.9	20.4	20.7	10.5	8.

0.9 oz. solid, 10.7 oz. liquid. [2] 12.1 oz. solid, 4.3 oz. liquid. [3] 12.6 oz. soli oz. liquid. [4] 15.9 oz. solid, 5.4 oz. liquid. [5] 15.2 oz. solid, 6.1 oz. liquid. [6] 8 o l, 11 oz. liquid. [7] 9.7 oz. solid, 9.7 oz. liquid. [8] 12.2 oz. solid, 8.1 oz. liqui

BLE XVI.—NET WEIGHT OF VARIOUS PACKAGE GOODS.—*Continued.*

Brand and Manufacturer.	No. Packages weighed.	Net Weight. Maximum.	Net Weight. Minimum.	Net Weight. Average.	Cost per package.	Average cost
		oz.	oz.	oz.	cts.	c
Mushrooms.						
Diane Selected. Von Bremen, Asche and Co., lew York	12	15.7	15.0	[14] 15.4	23	23
Diane Pieces and Stems. Von Bremen, Asche and o., New York	12	15.2	14.6	[15] 14.9	16	17
Peas.						
gnes Sweet Wrinkled. Fredonia Pres. Co., Fredonia, N. Y.	24	21.9	21.5	[16] 21.7	10.5	7
ter-Nut Little Gem Sifted. Fredonia Pres. Co., redonia, N. Y.	24	21.1	21.0	[17] 21.0	12.5	9
w Process Green Split. The Cleveland Seed Co., von, N. Y.	12	16.4	15.9	16.0	10.5	10
Red Peppers.						
ientos Morrones. Fabr. Espec. de Cons. Veg., alahorra, Spain	18	17.4	14.4	[18] 16.6	13	12
ientos Morrones. Fabr. Espec. de Cons. Veg., alahorra, Spain	12	8.4	7.6	[19] 8.0	8	16
Pumpkin.						
den Solid Dry Packed. U. H. Dudley and Co., lew York	12	37.9	37.5	[20] 37.6	10	4
gnes Golden. Fredonia Pres. Co., Fredonia, N. Y.	12	33.2	33.1	33.2	9.5	4
Spinach.						
ter-Nut Spring. Fredonia Pres. Co., Fredonia, . Y.	12	34.0	32.9	33.4	12	5
Succotash.						
ter-Nut Green Lima. Fredonia Pres. Co., Fredonia, N. Y.	24	21.3	19.3	20.8	11.5	8
gnes. Fredonia Pres. Co., Fredonia, N. Y.	23	21.6	19.6	20.8	9.5	7
Tomatoes.						
ter-nut Hand Packed. Fredonia Pres. Co., Fredonia, N. Y.	24	21.0	17.8	19.5	9.5	7
f Moon Hand Packed. The Wm. H. Geer Co., ew York	12	36.4	33.2	34.6	12.5	5
yland Special. Phillips Packing Co., Cambridge, d.	12	33.2	32.3	[21] 32.7	11.5	5
Fox Solid. The Wm. H. Geer Co., New York	12	33.7	31.1	32.6	12.5	6
o Peeled. Soc. Gen. delle Cons. Alim. Cirio, S. iovanni, Italy	12	18.3	15.9	17.5	8	7

7.4 oz. solid, 8.0 oz. liquid; claimed net wgt., 15 oz. [15] 6.8 oz. solid, 8.1 oz. liqui .9 oz. solid, 7.8 oz. liquid. [17] 13.4 oz. solid, 7.6 oz. liquid. [18] Claimed net wg oz. [19] Claimed net wgt., 7 oz. [20] Hand-stamped indistinctly "3% corn starch cessive liquor small pieces, fruit not fully ripe.

ɪʟᴇ XVI.—Nᴇᴛ Wᴇɪɢʜᴛ ᴏꜰ Vᴀʀɪᴏᴜs Pᴀᴄᴋᴀɢᴇ Gᴏᴏᴅs.—*Continued.*

Brand and Manufacturer.	No. Packages weighed.	Net Weight. Maximum.	Minimum.	Average.	Cost per package.	Average cost per lb.
		oz.	oz.	oz.	cts.	cts.
Fruits.						
Cherries.						
ıl Am. Golden Gate Packing Co., San Jose, Cal.	12	32.2	30.8	[22]31.4	23	11.
h's Preserved White, Oval. A. Booth and Co., ltimore, Md.	24	21.4	19.8	[23]20.7	12.5	9.
bud, Colored and Flavored. Rheinstrom Bros., ncinnati	8	31.6	31.0	[24]31.3	55	28.
Peaches.						
bo Pie. Miller Bros. and Co., Baltimore, Md.	12	33.1	31.3	[25]32.4	10.5	5.
ow Free. *Golden Gate Packing Co., San Jose, Cal.*	12	31.3	29.7	[26]30.5	19	10.
d Lemon Cling. Golden Gate Packing Co., San se, Cal.	12	31.4	30.3	[27]31.0	20	10.
Pears.						
an Extra Bartlett. The Wm. H. Geer Co., New rk.	24	21.3	19.4	[28]21.0	12.5	9.
ett. Golden Gate Packing Co., San Jose, Cal.	12	31.5	30.1	[29]30.5	21	11.
Pineapple.						
ıl Hawaiian Sliced. Haiku Fruit and Pack. Co., ıiku, H. I.	24	23.6	21.8	[30]22.9	21	14.
Plums.						
an Extra Lombard. The Wm. H. Geer Co., New rk.	24	21.3	20.9	[31]21.1	8	6.
Fish.						
erwood's Clams. Wm. Underwood Co., Boston.	12	16.4	15.6	[32]16.2	10	9.
sant River Maine Clams. H. S. Kane, *Brooklin,* e.	12	16.3	14.9	[33]16.1	8	8.
ıi Crab. S. Izumi, Hokkaido, Japan.	12	16.4	16.2	16.4	30	29.
Flakes, Cod and *Haddock.* *Burnham* and Mor- l Co., Portland, Me.	12	10.1	7.2	8.5	7.5	14.
ings in Tomato Sauce. Marshall and Co., Aber- en, Scot.	12	18.8	17.6	18.3	14	12.
ered Herrings. Marshall and Co., Aberdeen, Scot.	12	17.1	16.2	16.6	14	13.
ıe's Karluk Red Salmon. Alaska Packers Asso., n Francisco.	12	17.5	16.9	17.3	17	15.
er-Nut Columbia River Spring Salmon. F. C. shnell Co., New Haven.	12	15.9	14.4	15.3	21	22.
er-Nut Columbia River Spring Salmon. F. C. shnell Co., New Haven.	12	8.1	7.6	7.9	12.5	25.
le Barataria Shrimp. Pelican Lake Oyst. and ck. Co., Houma, La.	12	10.9	10.3	[34]10.7	10	14.

8.9 oz. solid, 12.5 oz. liquid. [23] 11.8 oz. solid, 8.9 oz. liquid. [24] 20.1 oz. solid oz. liquid. [25] 16.9 oz. solid, 15.5 oz. liquid; skins not removed. [26] 19.5 oz. solid oz. liquid; claimed net wgt., 30 oz. [27] 20.5 oz. solid, 10.5 oz. liquid; claimed n [illegible]

'ABLE XVI.—NET WEIGHT OF VARIOUS PACKAGE GOODS.—*Continue*

Brand and Manufacturer.	No. Packages weighed.	Net Weight. Maximum.	Net Weight. Minimum.	Net Weight. Average.	Cost per package.	
		oz.	oz.	oz.	cts.	
Meats.						
ech-Nut Sliced Bacon. Beech-Nut Pack. Co., Canajoharie, N. Y.	12	10.1	8.9	[35] 9.7	25	4
ech-Nut Sliced Beef. Beech-Nut Pack. Co., Canajoharie, N. Y.	12	8.8	8.0	[36] 8.3	25	4
rned Beef. Libby, McNeill and Libby, Chicago...	12	12.3	11.7	[37] 12.1	16	2
" " " " " " "	12	24.8	23.4	24.2	27.5	1
ned Chicken. Richardson and Robbins, Dover, Del.	12	14.1	12.8	13.6	46	5
tted Meat Beef Ham Flavor. Libby, McNeill and Libby, Chicago	18	3.9	3.6	[38] 3.8	4	1
tted Meat Beef Ham Flavor. Libby, McNeill and Libby, Chicago	12	5.5	5.1	[39] 5.4	8	2
oked Lunch Tongues. Libby, McNeill and Libby, Chicago	12	13.2	11.9	12.6	27.5	3
Soups.						
ck Turtle. Franco-American Food Co., Jersey City, N. J.	12	17.7	16.9	17.3	17	1
mato Puree. Franco-American Food Co., Jersey City, N. J.	12	8.6	8.2	8.5	7.5	1
mato. Jos. Campbell Co., Camden, N. J.	18	11.9	11.3	[40] 11.5	7.5	1
Preserves.						
ech-Nut Peanut Butter. Beech-Nut Pack. Co., Canajoharie, N. Y.	12	7.2	6.7	[41] 7.1	12	2
mpound Pineapple. Logan, Johnson and Co., Boston	4	14.3	13.2	13.7	8	
ım and Apple. Logan, Johnson and Co., Boston..	4	13.9	13.3	13.7	8	
spberry and Apple. Logan, Johnson and Co., Boston	8	13.7	13.2	13.4	8	
awberry and Apple. Logan, Johnson and Co., Boston	8	14.0	12.7	13.3	8	
ion Preserved Strawberries. Platt and Co., Baltimore, Md.	12	11.7	11.4	[42] 11.5	8	1
ple Jelly Currant Flavor	12	9.9	9.6	9.8	15	2.
Syrups, Molasses, Honey.						
Washington Maple Sap Syrup. Bay State Maple yrup Co., Boston	12	19.4	17.5	18.5	20	1
tmeg Fancy Cane and Maple. Miner, Read and 'ullock, New Haven	12	10.3	9.8	10.0	7.5	1
ro. Corn Products Refining Co., New York	12	32.2	31.9	[43] 32.0	8	
nt Dinah N. O. Molasses. Renick and Ford, New Orleans, La.	12	31.3	29.9	30.4	7.5	
npound Honey. Chas. Israel and Bros., New York	6	7.8	7.0	7.4	8	1

laimed net wgt., 9 oz. [38] Claimed wgt., 3.5 oz. [41] Claimed wgt., 7 oz.
laimed net wgt., 8 oz. [39] Claimed wgt., 6.5 oz. [42] 4.4 oz. solid, 7.1 oz. liqu
laimed net wgt., 12 oz. [40] Claimed wgt., 10.5 oz. [43] Claimed net wgt., 2 lbs.

ᴀʙʟᴇ XVI.—Nᴇᴛ Wᴇɪɢʜᴛ ᴏғ Vᴀʀɪᴏᴜs Pᴀᴄᴋᴀɢᴇ Gᴏᴏᴅs.—*Continued.*

Brand and Manufacturer.	No. Packages weighed.	Net Weight. Maximum.	Minimum.	Average.	Cost per package.	Average c
		oz.	oz.	oz.	cts.	c
Pickles and Relishes.						
ster Cocktail Sauce. T. A. Snider Pres. Co., Cincinnati	12	9.8	9.5	[44] 9.7	12	19
ıe Label Tomato Ketchup. Curtice Bros. Co., ɫochester, N. Y	12	17.4	17.0	17.3	18	16
ı Penny Chow Chow Pickles. The Williams Bros. ;o., Detroit	11	8.8	8.4	8.6	8	14
:li Sauce. The Williams Bros. Co., Detroit	12	9.3	8.3	8.8	8	14
ı Penny Sweet Gherkin Pickles. The Williams ẞros. Co., Detroit	12	9.1	8.1	8.7	8	14
ı Penny Sweet Fancy Mixed Pickles. The Williams ẞros. Co., Detroit	12	8.1	7.6	7.9	8	16
eet Relish Pickles. The Williams Bros. Co., Detroit	12	10.8	10.4	10.7	8	12
ad Dressing. E. R. Durkee and Co., New York	12	3.6	3.5	[45] 3.6	8	35
Condensed Milk.						
gnolia Brand. Borden Cond. Milk Co., New York	12	14.9	14.7	[46] 14.8	10	1c
ı Camp's Evaporated. Van Camp Packing Co., ndianapolis	12	6.0	6.0	[47] 6.0	4	1c
ı Camp's Evaporated. Van Camp Packing Co., ndianapolis	12	17.1	16.7	[48] 16.9	8	7
ıare Brand Skimmed. Hires Cond. Milk Co., Philadelphia	12	12.4	12.3	12.4	7.5	9
Pastes.						
tter-Nut Alimentary Paste, Mezzani. F. C. Bushell Co., New Haven	12	16.8	15.6	[49] 16.2	11	16
dium Egg Macaroni. Freihofer Vienna Baking ;o., Philadelphia	12	16.3	13.4	[49] 15.1	10	1c
; Elbow Macaroni. Freihofer Vienna Baking Co., 'hiladelphia	12	15.9	14.7	[49] 15.6	10	1c
ger's Golden Seal Macaroni	12	6.7	5.5	6.1	7.5	2c
g Brand Fine Egg Noodles. C. F. Mueller Co. ersey City, N. J	12	7.8	7.2	7.5	8	17
d Leaf Egg Noodles Medium. Freihofer Vienna ɫak. Co., Phila	12	8.5	7.9	8.2	10	19
ld Leaf Egg Elbow Spaghetti. Freihofer Vienna ɫak. Co., Phila	12	16.0	14.6	[49] 15.4	10	1c
ɪghetti Italian Style. Van Camp Packing Co., ndianapolis	36	21.9	21.0	21.5	12	8
ɪinx Superior White Vermicelli. Miner, Read and 'ullock, New Haven	12	14.8	14.3	14.5	7	7

laimed net wgt., 8 oz. [46] Claimed net wgt., 14.5 oz. [48] Claimed net wgt., 16 oz.
'laimed net wgt., 3.25 oz. [47] Claimed net wgt., 6 oz. [49] Claimed wgt., 1 lb.

ABLE XVI.—NET WEIGHT OF VARIOUS PACKAGE GOODS.—*Continu*

Brand and Manufacturer.	No. Packages weighed.	Net Weight. Maximum.	Minimum.	Average.	Cost per package.
		oz.	*oz.*	*oz.*	*cts.*
Crackers and Biscuits.					
›% Gluten Biscuit. The Kellogg Food Co., Battle Creek, Mich.	4	7.0	6.2	6.7	30
›% Gluten Biscuit. The Kellogg Food Co., Battle Creek, Mich.	9	3.5	2.7	3.1	25
reakfast Toast. The Kellogg Food Co., Battle Creek, Mich.	6	9.2	8.7	9.0	13
ducator Toasterettes. Johnson Educator Food Co., Boston	12	12.4	10.8	[50] 11.4	25
ducator Animal Crackers. Johnson Educator Food Co., Boston	5	14.8	13.9	[51] 14.4	25
ruited Educator. Johnson Educator Food Co., Boston	5	11.0	10.7	10.8	25
ipanese Friendship Wafers. Banta and Van Buskirk, New York	10	4.1	3.2	3.5	25
ostonia Sugar Wafers. O. B. Gilman, Boston	7	3.7	3.2	3.4	10
ıgar Wafers, Chocolate. Huntley and Palmer, Reading, Eng.	12	5.3	4.6	4.9	38
epublic Chocolate Wafers. G. J. R. Wafer Bakery, Freeville, N. Y.	12	14.3	12.5	13.3	45
estino Almonds. National Biscuit Co., New York	6	5.2	4.8	[52] 5.1	25
hocolate Tokens. " " " " "	12	6.5	5.4	[47] 6.0	25
hampagne Wafers. " " " " "	12	6.0	4.6	[53] 5.3	25
abisco Chocolate. " " " " "	12	3.6	2.6	[54] 3.0	10
abisco Vanilla. " " " " "	8	6.7	6.0	[55] 6.5	25
›cial Tea Biscuit. " " " " "	9	6.7	6.3	[55] 6.6	10
rotana. " " " " "	12	8.8	7.7	[56] 8.4	10
ıltine Biscuit. " " " " "	10	6.1	5.3	[57] 5.6	10
" " " " " " "	6	*11.5*	9.8	*10.7*	*15*
ve O'Clock Tea Biscuit. National Biscuit Co., New York.	6	6.5	6.2	[55] 6.3	10
ıronet Biscuit. National Biscuit Co., New York	6	15.1	14.1	[50] 14.5	25
g Newtons. " " " " "	8	10.0	8.1	[56] 8.9	10
needa Lunch Biscuit. National Biscuit Co., New York	8	5.1	4.4	[52] 4.6	5
ydrox Chocolate Biscuits. Loose-Wiles Biscuit Co., Boston	4	8.3	7.8	8.1	30
ınshine Brandywine. Loose-Wiles Biscuit Co., Boston	8	5.9	4.7	5.4	25
ınshine Veronique. Loose-Wiles Biscuit Co., Boston	12	2.2	1.9	2.1	10
ınshine Tan-San. " " " " "	8	3.0	2.3	2.6	15
ınshine Butter Thin. " " " " "	1	....	....	7.1	10

Claimed net wgt., 12 oz.
Claimed net wgt., 14 oz.
Claimed net wgt., 4.5 oz.
[47] Claimed net wgt., 6 oz.
[53] Claimed net wgt., 5 oz.
[54] Claimed net wgt., 2.75 oz.
[55] Claimed net wgt., 6.2
[56] Claimed net wgt., 8.5 c
[57] Claimed net wgt., 5.25

ABLE XVI.—NET WEIGHT OF VARIOUS PACKAGE GOODS.—*Concludec*

Brand and Manufacturer.	No. Packages weighed.	Net Weight. Maximum.	Minimum.	Average.	Cost per package.	Average cost
		oz.	oz.	oz.	cts.	c
Cereals.						
llogg's Toasted Corn Flakes. Kellogg T. C. F. Co., Battle Creek	12	11.1	8.7	[40]10.1	8	12
aker Toasted Corn Flakes. Quaker Oats Co., Chicago	12	9.5	9.0	9.2	8	13
aker Rolled White Oats. Quaker Oats Co., Chicago	12	22.8	22.0	[58]22.5	8.5	6
fceco Rolled Oats. Buffalo Cereal Co., Buffalo, N. Y.	12	23.9	23.4	24.1	8.5	5
cker's Cream Farina. Hecker-Jones-Jewell Mill. Co., New York	12	32.7	32.3	32.4	12.5	6
ndma's Pancake Flour Comp. Hecker-Jones-Jewell Mill. Co., New York	12	32.1	31.8	31.9	8.5	4
iable Self-Raising Prep. Flour. Reliable Flour Co., Boston	12	23.9	23.7	[59]23.8	10	6
Miscellaneous.						
yal Baking Powder. Royal Baking Powder Co., New York	12	8.4	7.9	[60] 8.0	20	40
yal Baking Powder. Royal Baking Powder Co., New York	12	4.0	3.8	[61] 4.0	11	44
nham's Orig. Shred Cocoanut. Dunham Mfg. Co., Brooklyn, N. Y.	12	4.7	3.6	[61] 4.0	7	28
nham's Orig. Shred Cocoanut. Dunham Mfg. Co., Brooklyn, N. Y.	12	9.8	7.9	[60] 8.7	13.5	24
ne Such Mince Meat. Merrell-Soule Co., Syracuse, N. Y.	12	11.0	10.9	[62]10.9	8.5	12
sco The Procter and Gamble Co., Cincinnati	12	24.2	24.1	24.1	20	13
lo Ice Cream Powder. Genesee Pure Food Co., Le Roy, N. Y.	12	5.0	4.8	4.9	7.5	24
'phosa. E. C. Rich, New York	12	7.4	6.6	[19] 7.2	8	17
Dried Fruits.						
ter-Nut Fancy Evap. Apples. F. C. Bushnell Co., New Haven	12	14.7	14.0	14.3	12.5	14
v-us Brand Cleaned Currants. Serv-us Pure Food Co., New York	12	14.9	13.9	14.6	11	12
nogram Brand Dates. William Hills, Jr., New York	12	13.9	12.2	12.9	7.5	9
y Best Prunes Gold Medal Brand. Santa Clara Co., Cal.	12	13.0	11.9	12.4	10	12
ter-Nut Fancy Seeded Raisins. F. C. Bushnell Co., New Haven	12	15.2	14.9	15.1	10	10

laimed wgt., 10.5 oz.
laimed net wgt., 22 oz.
laimed net wgt., 1.5 lbs.
[60] Claimed net wgt., 8 oz.
[61] Claimed net wgt., 4 oz.
[62] Claimed net wgt., 10 oz.
[19] Claimed net wgt., 7 oz.

sider, however, that the peaches of this brand were unskinned and that the can contained 48 per cent. of juice against only 36 per cent. in the other, the apparent relative cheapness of this brand to a great extent disappears. Similar comparisons could be made with many other brands, but we cannot consider the whole table in detail.

The prices show another very important point, namely, the expensivaness of certain classes of canned products. Perhaps the consumer does not realize, when purchasing the thin-sliced bacon or smoked beef of undoubted delicious quality, he is paying 41 cents per pound for the former and 48 cents for the latter. In Potted Meat Beef Ham Flavor, formerly generally understood by the consumer to be "Potted Ham," but now revealed in its true light, he pays 17 or 24 cents per pound, depending on the size of the package, rather a high price for beef of inferior quality. Macaroni or noodles at 20 cents per pound is certainly not an economical purchase. The prices paid for crackers, especially in the smaller packages, are notably high. Cleanliness in manufacture and subsequent handling, of course, are important, but do they justify such prices as 92 cents, $1.14 or $1.24 per pound, to mention only a few of our most costly brands? Plain crackers, like Saltines, costing 29 cents per pound are hardly an economical food. Certain cereals like cornflakes are sold in what appear to be very generous packages, but the flakes in them cost 12.7 to 13.9 cents per pound.

Further details will not be cited, but we believe a careful study of Table XVI will give much useful data that have an important bearing on the "high cost of living."

II. DRUG PRODUCTS.

ACETIC ACID.

(*Acidum Aceticum.*)

The Pharmacopœia defines acetic acid as "a liquid composed of not less than 36 per cent. by weight of absolute acetic acid, and about 64 per cent. of water, and obtained by the oxidation of ethyl alcohol or by the destructive distillation of wood."

Table XVII.—Acetic Acid.

	Place of Sale.	Cost per 4 oz.	Specific gravity at 15° C.	Acetic Acid.	*Fixed Impurities* (gms. per 100 cc.).	Remarks.
		cts.		%		
19	*Bridgeport........*	*10*	*1.048*	34.82	*.013*	
20	Bridgeport........	10	1.019	12.60	.010	35% U. S. P.
21	Bridgeport........	10	1.048	35.06	.018	
5	Danbury...... ...	15	1.048	34.82	.305	Considerable chlorides.
6	Hartford..........	15	1.049	35.27	.008	
7	Hartford..........	20	1.047	34.14	.011	
8	Hartford..........	20	1.049	35.63	.005	Formic and sulphurous acid pre
6	Meriden..........	10	1.049	35.51	.315	Brown color; contains iron, formic and sulphurous acids, trace of empyreumatic substanc
7	Meriden..........	10	1.040	28.18	.058	78.3% U. S. P.; contains empyreu substances and trace of sulphat
3	*New Britain.......*	*15*	*1.049*	35.48	*.014*	
4	New Britain.......	20	1.049	35.45	.020	
9	New Haven.......	20	1.049	35.60	.033	
0	New Haven.......	15	1.050	36.02	.017	
8	New Haven.......	10	1.040	28.51	.064	Contains empyreumatic substance trace of sulphates. 79.2% U. S.
9	New Haven.......	20	1.052	37.92	.016	
2	New London......	15	1.049	35.81	.010	
3	New London......	20	1.049	35.57	.012	
2	New London......	25	1.049	35.51	.004	
0	Norwich..........	10	1.049	35.69	.003	Contains trace of formic and sul ous acid.
1	*Norwich..........*	*20*	*1.049*	35.69	*.006*	
1	Stamford..........	15	1.008	6.05	.015	16.8% U. S. P.
2	Stamford..........	10	1.040	28.21	.026	78.4% U. S. P.; contains trace chlorides.
9	Waterbury........	20	1.049	35.39	.020	
0	Waterbury........	25	1.049	35.51	.016	
1	Waterbury........	15	1.044	31.10	.018	86.4% U. S. P.
	Sampled by Dairy Commissioner.					
7	[1]A. L. Embree, Stamford........	..	.....	28.12	....	78.1% U. S. P.
8	[2]Marron's Pharmacy, Stamford..	..	.....	34.32	....	
0	[3]J. H. Clampett, Bridgeport......	..	.....	35.98	....	

[1] See 27592 above. [2] See 27591 above. [3] See 27520 above.

It should have a specific gravity of about 1.045 at 25° C. (equal to 1.048 at 15° C.), should leave no residue on evaporation, should be free from sulphuric, hydrochloric, formic and sulphurous acids,

Twenty-eight samples were analyzed. These contained from 6.05 to 37.92 per cent. acetic acid. Twenty-one samples contained approximately the standard percentage. The other seven contained 6.05, 12.60, 28.12, 28.18, 28.21, 28.51 and 31.10 per cent., respectively. Two of these, **27591** and **27520**, showed a great deficiency in acid, containing only 17 and 35 per cent. of the required amount.

Of the twenty-one samples containing over 34 per cent. of acetic acid four failed to comply strictly with the U. S. P. requirements, one containing high fixed impurities, mostly chlorides, two traces of formic and sulphurous acids, and one, **27576**, being of a decided brown color and containing high fixed impurities, iron, lead, formic and sulphurous acids and traces of empyreumatic substances.

To summarize, 17 samples were found to be of satisfactory quality, 4 of proper acid strength contained various impurities and 7 contained only from 17 to 86 per cent. of the required acid.

The three samples taken by the Dairy Commissioner were second samples from the stock of druggists found by the station to be selling this drug below standard strength, **6147**, corresponding to our **27592**, showed no change; **6148** and **6170**, corresponding to **27591** and **27520**, however, showed 34.32 and 35.98 per cent., respectively, where 6.05 and 12.60 were previously found, another indication that the three-sample feature of the law may put the dealer on guard and that the material sold does not necessarily represent what would be secured by the casual purchaser.

ACONITE.

(Aconitum.)

"The dried tuberous root of *Aconitum Napellus*, collected in autumn; yielding when assayed by the process given below (U. S. P. page 28), not less than 0.5 per cent. of aconitine."

Seven samples of the powdered root were analyzed.

Aconitine was determined by four methods, the U. S. P. gravimetric and volumetric and the A. O. A. C. gravimetric and volumetric (U. S. Dept. Agr., Bur. of Chem., Bull. *107*, 258). Neither gravimetric method is reliable because of the difficulty in securing a perfectly pure residue from the ether and chloroform

extraction. The following tabulation of results shows that in certain cases the amount of impurity may be very considerable.

ACONITINE BY DIFFERENT METHODS.

Sample.	U. S. P. Method. Grav. %	U. S. P. Method. Vol. %	A. O. A. C. Method. Grav. %	A. O. A. C. Method. Vol. %
27747	*.494	.384	.430	.371
27495	.335	.295	.301	.256
27548	*.383	.231	.308	.288
27658	.454	.397	.448	.359
27682	*.415	.231	*.387	.256
27705	†.725	.487	.581	.512
27588	.487	.397	.486	.410
Averages,	.470	.346	.420	.350

* Residue *impure.* †*Residue very impure.*

These results show very clearly the tendency towards high results by both gravimetric methods, and that there is little choice between the two volumetric methods as regards accuracy.

With the exception of **27705**, all the samples were deficient in the alkaloid, ranging from 0.231 to 0.397 per cent., or from 46.2 to 79.4 per cent. of the strength required by the U. S. P.

Total ash ranged from 4.52 to 6.05, and ash insoluble in hydrochloric acid (sand) from 0.13 to 1.30 per cent. There was a

TABLE XVIII.—ACONITE ROOT (POWDERED).

Station No.	Place of Sale.	Cost per 2 oz.	Weight sold for 2 oz.	Aconitine. U. S. P. method, Volumetric.	Aconitine. A. O. A. C. method, Volumetric.	Ash. Total.	Ash. Insoluble in HCl.
		cts.	oz.				
27747	*Hartford	15	2.2	0.384	0.371	6.05	0.72
27495	*†New Haven	10	1.8	0.295	0.256	5.47	1.23
27548	"	10	1.8	0.221	0.288	5.61	1.04
27658	New London	10	1.7	0.397	0.359	5.48	0.65
27682	"	20	2.4	0.231	0.256	5.62	1.30
27705	Norwich	10	1.8	0.487	0.512	5.36	0.31
27588	Stamford	20	1.8	0.397	0.410	4.52	0.13
	Average	*13.6*	*1.9*	*0.346*	*0.350*	*5.44*	*0.77*

* **No Poison label.** † **Labeled "not pure."**

relation between insoluble ash and aconitine, the higher percentages of alkaloid being associated with a low insoluble ash.

The samples were carelessly weighed at the time of sale. Although two ounces were asked for in every case, the amount delivered ranged from 1.7 to 2.4 ozs., at a cost of from 10 to 20 cents. Although the substance is actively poisonous two druggists neglected to affix a poison label to their samples.

POWDERED ASAFETIDA.

The Pharmacopœia requires that gum asafetida shall contain not less than 50 per cent. of matter soluble in alcohol and not more than 10 per cent. of ash.

The quality of gum asafetida is notoriously bad and that of the powdered drug is even worse. The literature shows that much inferior asafetida is imported into this country, some containing as much as 75 per cent. of ash. On the other hand numerous samples have been found containing over 70 per cent. of alcohol-soluble resins and less than 6 per cent. of ash.

Because of its gummy nature it is claimed that a diluent is necessary when asafetida is to be prepared in powdered form. However, an ash content of 40, 50 or even 65 per cent. is inexcusable, and can only be considered as an adulteration. (See page 204.)

Twenty-seven samples were analyzed, representing seventeen samples taken by us and ten duplicate samples collected by the Dairy Commissioner.

The alcohol-soluble matter ranged from 11.58 to 60.50 per cent., as follows:

9	samples	from	11.6 to 20.0	per cent.
10	"	"	20.1 to 30.0	"
5	"	"	30.1 to 40.0	"
2	"	"	40.1 to 50.0	"
1	"	"	60.5	"

In other words 15 of the 27 samples contained less than half of the required amount of alcohol-soluble matter. As a rule the low percentages of resins were associated with large amounts of ash. The last column of Table XIX shows the calculated amount of alcohol extract based on 10 per cent. of ash (the U. S. P. maxi-

TABLE XIX.—POWDERED ASAFETIDA.

Station No.	Label.	Place of Sale.	Weight, oz.		Selling Price.	Alcohol Extract.	Ash.			CaO.	SO_3.	Alcohol Extract on basis of 10 per ct. ash. (Calculated).
			Claimed.	Found.			Total.	Insoluble in water.	Insoluble in HCl.			
					cts.							
27530	Asafetida Powd.........	Bridgeport.........	2.0	2.0	20	41.34	34.73	31.00	1.92	*15.06	10.05	56.97
27944	Asafetida Powd.........	Bristol............	1.0	0.9	25	19.46	49.58	46.20	1.53	20.89	24.33	34.74
27738	Asafetida Powd.........	Hartford...........	1.0	0.9	10	12.14	46.03	40.80	0.82	*19.67	22.88	20.25
27746	Asafetida Powd.........	Hartford...........	1.0	0.8	10	49.90	35.99	32.51	1.13	14.10	19.27	70.16
27973	Asafetida..............	Hartford...........	1.0	0.8	15	35.62	37.92	32.03	1.83	*17.39	10.41	51.66
27974	Asafetida..............	Hartford...........	1.0	0.8	25	15.02	63.03	51.74	0.87	*32.03	18.29	36.54
27975	Asafetida..............	Hartford...........	1.0	0.9	25	36.36	36.96	34.13	1.40	14.52	18.94	53.55
27976	Po. Asafetida..........	Hartford...........	1.0	1.0	15	24.26	50.02	44.51	1.50	*22.20	20.25	43.65
27572	Pow. Gum Asafetida ...	Meriden............	1.0	0.8	10	27.12	48.64	42.96	2.62	*16.72	13.93	47.52
27959	Po. Asafetida..........	New Britain	1.0	1.0	15	27.56	52.22	47.09	1.18	*30.93	15.14	51.93
27960	Powd. Asafetida	New Britain........	1.0	0.8	20	23.58	46.43	43.63	4.44	18.41	19.74	39.60
27498	Asafetida..............	New Haven..........	1.0	0.9	10	13.24	64.49	59.70	2.16	25.72	32.88	33.57
27752	Asafetida..............	New Haven..........	1.0	0.9	10	25.52	45.23	40.32	2.47	*19.52	15.23	41.94
27681	Powd. Asafetida	New London.........	1.0	0.8	10	60.50	27.06	22.95	0.98	10.79	13.19	77.65
27586	Asafetida..............	Stamford	1.0	0.7	10	24.40	58.68	52.91	2.45	23.51	28.05	53.19
27786	Asafetida	Waterbury..........	1.0	0.9	15	34.80	28.11	24.77	1.54	*11.45	7.21	43.56
27788	Asafetida..............	Waterbury..........	1.0	1.1	10	11.78	67.84	63.29	1.27	27.17	34.97	32.94
		Average..........	...	...	..	*28.39*	*46.64*	*42.18*	*1.77*	*20.00*	*19.10*	*47.90*

* Contained considerable lime as carbonate.

mum for the gum). This shows approximately the amount of alcohol-soluble matter in gum of U. S. P. quality as regards ash. These calculated values ranged from 19.71 to 77.65 per cent., or

2	samples from	19.7 to 30.0	per cent.
8	" "	30.1 to 40.0	"
8	" "	40.1 to 50.0	"
9	" "	50.1 to 77.7	"

These figures indicate that in 9 samples the original gum was of U. S. P. quality, in 8 of fairly satisfactory quality, while in 10 it was decidedly inferior. Whatever justification there may be in the use of a certain amount of diluent in powdering the gum, the above figures show that in nearly half of the samples the gum itself was not of U. S. P. strength.

The total ash ranged from 27.06 to 67.84 per cent., the ash insoluble in water from 22.95 to 63.29 per cent. and that insoluble in hydrochloric acid (sand) from 0.82 to 2.62 per cent. The samples may be classed as follows on basis of total ash.

2	samples from	27.1 to 30.0	per cent.
5	" "	30.1 to 40.0	"
10	" "	40.1 to 50.0	"
3	" "	50.1 to 60.0	"
7	" "	60.1 to 67.8	"

TABLE XX.—POWDERED ASAFETIDA.

(Sampled by Dairy Commissioner.)

Sample No.	* Corresponding Station No.	Dealer.	Alcohol Extract.	Total Ash.	Alcohol Extract on basis 10 per cent. Ash (calculated).
6367	27498	Chas. Fleischner, New Haven	13.52	63.83	33.64
6368	27752	Chas. S. Leete & Co., New Haven	25.36	43.80	40.59
6388	27586	A. L. Embree, Stamford	34.28	49.33	60.89
6397	27944	P. N. Holley, Bristol	21.40	49.12	37.89
6558	27572	W. W. Mosher, Meriden	26.00	46.24	43.52
6565	27974	Cantarow Drug Co., Hartford	15.26	66.94	41.58
6566	27975	Frank L. Palmer, Hartford	36.58	37.17	52.38
6567	27738	L. H. Tracy, Hartford	11.58	47.08	19.71
6569	27959	E. L. Janeswick, New Britain	26.26	64.18	65.97
6585	27788	J. W. Cone, Waterbury	12.20	66.88	33.15

* See Table XIX.

No *sample approached even the* U. S. P. *maximum and ten* :ontained over 50 per cent. ash.

The ash consisted chiefly of calcium sulphate, in fourteen sam-)les associated with considerable calcium carbonate.

The selling price showed the usual variations, ranging from 10 o 25 cents per ounce.

The ten second samples taken by the Dairy Commissioner Table XX) ranged from 11.58 to 36.58 per cent. alcohol extract .nd from 37.17 to 66.94 per cent. ash; in other words none of he samples satisfied the U. S. P. requirements. With one xception the analyses of these samples agreed reasonably well vith those of the corresponding station samples.

SYRUP OF FIGS.

This proprietary has been on the market for a number of years. t was formerly sold as "Syrup of Figs," but of late years many f the labels note the presence of "Elixir of Senna," which is enerally the real laxative agent present. The reason for this hange is apparent from the following extract from the opinion f the U. S. Court in the case, Worden v. California Fig Syrup :o., 187 U. S., 516, 536:

"The argument for complainant is that, because fig juice or syrup as no laxative property, everybody ought to understand that when the :rm is used to designate a laxative medicine it must have only a ınciful meaning. *But the fact is admitted that the public believe that* g juice or syrup has laxative medicinal properties. It is to them that ıe complainant seeks to sell its preparations, and it is with respect to ıeir knowledge and impression that the character, whether descriptive r fanciful, of the term used, is to be determined."

While whole figs do have a laxative effect, due largely to the ıechanical effect of the seeds and skins, there is no evidence that decoction of figs has any such action whatever. The public ıould understand that in the preparations under discussion the ıxative agent is not figs, but, generally, senna, often associated ·ith Rochelle or Epsom salts, which relieve the griping often esulting from the use of the senna alone.

Thirteen samples were analyzed, six of which were sold as ompound fig syrup, five as compound fig and senna syrup, and vo as fruit laxative.

TABLE XXI.—SYRUP OF FIGS.

Station No.	Brand.	Cost per bottle.	Specific gravity at 25° C.	Alcohol by weight.	Solids.	Ash. Total.	Ash. Water-Insoluble.	Sugar, by Clerget.	Polarization. Direct.	Polarization. After Inversion.	Polarization. Temperature ° C.
		cts.									
27533	*Amer. Druggists Syndicate, N. Y.*	25	1.294	1.46	63.08	0.69	0.26	56.01	54.6	—17.6	29
26943	California Fig Syrup Co., San Francisco	45	1.235	4.01	52.20	0.82	0.33	42.70	41.6	—14.1	24.5
27517	Dist. by Cosmopolitan Pharmacy, Bridgeport	35	1.303	1.88	60.35	1.18	0.34	44.90	46.8	—12.8	20
27516	Prep. for H. A. Dupee, Bridgeport	25	1.235	2.79	51.20	1.18	0.33	35.65	33.2	—12.8	26
27514	Prep. for J. A. Leverty & Bro., Bridgeport	25	1.293	4.72	63.42	0.76	0.09	55.36	53.4	—17.8	29
27515	New York & London Drug Co., N. Y.	20	1.268	9.63	57.84	4.92	0.26	42.00	41.6	—12.5	26
27779	North American Remedy Co., Philadelphia	25	1.285	4.78	62.15	0.74	0.12	52.21	50.8	—16.5	29
27535	Peninsula Chem. Co., Detroit	25	1.280	1.50	62.27	1.99	0.21	44.38	44.8	—14.1	20
26949	Dr. Hobson's. Pfeiffer Chem. Co., Philadelphia	25	1.262	0.00	57.44	0.80	0.36	*11.43	2.2	—12.5	29
26940	Riker Drug Stores, New York	35	1.314	1.46	65.09	0.47	0.26	61.28	61.0	—18.9	24.5
27518	Rexall. United Drug Co., Boston	45	1.270	2.91	61.07	0.63	0.31	44.33	42.4	—14.7	29
27568	Vita Drug Co., Boston	25	1.287	1.16	60.70	1.21	0.36	53.91	53.0	—16.5	29
27534	Henry S. Wampole Co., Baltimore	35	1.234	2.36	54.82	0.21	0.08	42.10	41.2	—13.2	29

* Also 33.61 per cent. invert sugar.

Brand Names.

27533. Premium Remedy for Constipation, A Vegetable Laxative, A. D. S. Fig Syrup Comp., Alcohol 3 per cent.

26943. Syrup of Figs and Elixir of Senna, Contains 6 per cent. of Alcohol.

27517. Laxative Fig Syrup and Compound Synergists, .03 Alcohol.

27516. Fig and Senna Laxative Compound Syrup, Alcohol 5 per cent.

27514. Compound Fig Laxative Syrup, Contains about 8 per cent. Alcohol.

27515. Nyal's Compound Laxative Fig Syrup, Alcohol 16 per cent. "A Purely Vegetable Laxative."

27779. Narco Fig Laxative Syrup, Contains about 8 per cent. Alcohol.

27535. Penslar Compound Laxative Fig and Senna Syrup, Alcohol 2 per cent. "Each fluidounce contains Senna, 175 grs., Rochelle Salts, 20 grs., Syrup of Figs, 80 Min."

26949. Dr. Hobson's Laxative Fig Syrup Compound, with Senna and other Vegetable Laxatives.

26940. Riker's Compound Syrup of Senna and Figs, 2½ per cent. Alcohol.

27518. Rexall Fruit Laxative, Containing 14 per cent. Alcohol.

27568. Vita Compound Fruit Laxative Syrup, 2 per cent. Alcohol. "Syrup Figs and Raisins, Syrup Prunes, Senna, Mandrake, Rhubarb, etc."

27534. Laxative Fig Syrup and Senna Compound, Alcohol 5 per cent.

With one exception all the samples contained alcohol ranging from 1.16 to 9.63 per cent. The solids ranged from 51.20 to 55.09 per cent., chiefly consisting of cane sugar, except in **26949**, where 11.43 per cent. cane sugar and 33.61 per cent. invert sugar were present; in the other samples the sugar ranged from 35.65 to 61.28 per cent., constituting from 70 to 94 per cent. of the solids.

The ash ranged from 0.21 to 4.92 per cent., while the water-insoluble ash ranged from 0.08 to 0.36 per cent. An examination of the ash showed traces of chlorides, lime, magnesium, phosphates, sulphates, and iron in all samples. Chlorides were found in considerable amount in **27515, 27535** and **25779**; magnesia in **27515, 27516, 27517, 27518** and **27568**; and sulphates in **27515, 27516, 27517, 27535** and **27568.** In four of these samples, **27515, 27516, 27517** and **27568,** magnesium sulphate (Epsom salt) was present, while **27518** contained an unidentified magnesium salt. In **27535** Rochelle salt was present. It is apparent, therefore, that the cathartic action was not in all cases derived solely from vegetable drugs, as claimed for some of the brands.

Generally speaking, since syrup of figs confessedly has no laxative property, it would seem to be a species of misbranding to give the words "fig syrup" so much prominence on the label of laxative remedies of this nature. By the manufacturer's own label in one case only 80 minims of syrup of figs is claimed per fluidounce, or 16 per cent., while 40 per cent. of senna is claimed. A statement made on the label of the California Fig Syrup Co. is illuminating in this respect. "This excellent remedy, well and favorably known under the name of Syrup of Figs, will in future be designated Syrup of Figs and Elixir of Senna, as the latter name is more fully descriptive of the combination, because its laxative principles are obtained from Senna, which is the best of natural laxatives, while the figs of California are used to promote the pleasant taste." There is, therefore, evidently no more reason why the word "fig" should appear on the labels of these preparations than the name of any other flavoring ingredient used, such as cassia, cloves or mint. The word "fig" is used with all the preparations except the Rexall and Vita products, which are called "Fruit Laxatives," a nomenclature just as objectionable, as in neither case is the main laxative effect secured from any fruit which may be present.

By subtracting the sum of the sugars and ash from the total solids, we get a close approximation to the amount of vegetable extractive present, assuming, of course, the absence of glycerine for which we made no tests. This figure ranges from 3.34 to 16.11 per cent., six samples containing less than 10 per cent.

When we consider the samples individually we find more specific criticisms necessary. The A. D. S. preparation, **27533**, bears the usual statement, "This is not a patent medicine, etc.," which raises the question whether a preparation made by a druggist or a group of druggists may not be quite as much a patent medicine as if made by a quack doctor or a seemingly reputable house.

In **27517** we find considerable Epsom salt. The brand name claims the presence of "synergists." Synergy, medically speaking, is "the combined healthy action of every organ of a system." The claim for the presence of such substances is certainly a most sweeping one.

In **27516** we also find considerable Epsom salt.

The Nyal preparation, **27515**, claiming to be a purely vegetable laxative, contains [illegible] per cent. ash, a considerable portion of

which is Epsom salt. It is therefore not "purely vegetable" and much of its laxative action depends upon a mineral cathartic. It contains 9.63 per cent. of alcohol by weight, more than double the amount found in any of the other samples.

27535, Penslar Syrup, contains Rochelle salt as claimed, also considerable chlorides and sulphates, indicating the use of other mineral drugs.

26940, Riker's Syrup, contains only 3.34 per cent. of solids, other than sugar and ash, 94 per cent. of its solids consisting of sugar. This contains less vegetable extractives than any other of the group.

27518, Rexall Fruit Laxative, contains a magnesium salt, to which part of its laxative action is probably due.

27568, Vita Syrup, contains considerable Epsom salt, which is not mentioned in its formula, and which is certainly not a "fruit," to which the manufacturer attributes the laxative effect of his preparation.

GLYCERINE.

(*Glycerinum.*)

Glycerine of U. S. P. strength should contain not less than 95 per cent. of absolute glycerine, should have a specific gravity not less than 1.246 at 25° C. (= 1.2526 at 15° C.), should be neutral to litmus paper, should be free from mineral impurities, sugars, butyric acid and acrolein.

Thirty samples were analyzed.

The specific gravity at 15° C. ranged from 1.2469 to 1.2630; absolute glycerine from 93.0 to 99.2.

Sugar was present in small quantity in one sample.

Butyric acid was present in all samples, but in nine cases only in traces.

Acrolein was absent in one sample, present in traces in sixteen, and in relatively considerable amounts in thirteen.

Arsenic was present in traces in ten samples.

No oxalic acid, calcium, chlorides or sulphates were detected in any sample.

The cost of four ounces ranged from 15 to 35 cents.

TABLE XXII.—GLYCERINE.

Station No.	Place of Sale.	Cost per 4 oz.	Specific gravity at 15° C.	Glycerine.	Sugars.	Butyric Acid.	Acrolein.	Arsenic.
		cts.						
27503	Bridgeport	25	1.2502	94.0	None	Yes	Trace	Non
27526	Bridgeport	25	1.2620	98.8	None	Trace	None	Non
27527	Bridgeport	20	1.2515	94.6	Yes	Yes	Yes	Non
27528	Bridgeport	15	1.2542	95.6	None	Yes	Trace	Non
27529	Bridgeport	15	1.2556	96.2	None	Yes	Yes	Non
27623	Danbury	20	1.2517	94.6	None	Yes	Trace	Non
27632	Danbury	20	1.2542	95.6	None	Yes	Trace	Non
27635	Danbury	35	1.2493	93.6	None	Yes	Trace	Trac
27723	Hartford	15	1.2510	94.4	None	Yes	Yes	Non
27724	Hartford	20	1.2575	97.0	None	Yes	Trace	Trac
27725	Hartford	15	1.2548	96.0	None	Yes	Yes	Trac
27729	Hartford	20	1.2592	97.6	None	Trace	Trace	Trac
27581	Meriden	15	1.2599	98.0	None	Trace	Trace	Trac
27582	Meriden	15	1.2629	99.2	None	Trace	Yes	Non
27565	New Britain	20	1.2516	94.6	None	Yes	Yes	Non
27566	New Britain	20	1.2555	96.2	None	Yes	Yes	Trac
26961	New Haven	20	1.2540	95.6	None	Yes	Trace	Trac
27494	New Haven	15	1.2588	97.6	None	Trace	Trace	Trac
27545	New Haven	20	1.2514	94.6	None	Yes	Yes	Non
27546	New Haven	20	1.2547	95.8	None	Yes	Trace	Non
27547	New Haven	25	1.2570	96.8	None	Yes	Trace	Non
27654	New London	30	1.2630	99.2	None	Trace	Trace	Trac
27656	New London	35	1.2515	94.6	None	Yes	Yes	Non
27702	Norwich	25	1.2597	98.0	None	Yes	Trace	Non
27714	Norwich	25	1.2580	97.2	None	Trace	Trace	Non
27589	Stamford	20	1.2520	94.8	None	Yes	Yes	Non
27590	Stamford	15	1.2555	96.2	None	Yes	Yes	Non
27766	Waterbury	15	1.2557	96.2	None	Yes	Trace	Trac
27767	Waterbury	25	1.2469	93.0	None	Trace	Yes	Non
27768	Waterbury	20	1.2552	96.0	None	Trace	Yes	Non
	Average	*20.8*	*1.2552*	*96.1*	.....	.....	.....	.....

HEROIN.

Heroin, diacetyl morphine, is a morphine derivative, which ha recently come into use to an alarming extent as a substitute fo cocaine and similar habit-forming drugs. The abuse of the drug has become so great that at least one city in this state, New Haven has passed an ordinance forbidding its sale except on prescription or for purely professional or scientific purposes. Four sample were purchased by our collector, whose identity was unknown t the druggists in question, the latter making no inquiries whateve as to the purpose of the purchase. While the sale of these samples was not illegal at the time, it is obviously easy for a

perfect stranger to purchase this dangerous drug without a prescription in at least four of our cities.

The samples contained from 4.03 to 19.75 per cent. of heroin, equivalent to 0.068 to 0.172 of a grain per tablet, one showing a shortage of .015 of a grain, or 18 per cent.

TABLE XXIII.—HEROIN TABLETS.

Station No.	Dealer.	Cost per Sample.	No. of Tablets.	Net weight of Tablets.	Heroin. Per cent.	Heroin. Grains per Tablet found.	Heroin. Grains per Tablet claimed.
		cts.		gm.			
27740	Pike's Drug Store, Hartford	10	12	1.118	6.02	.087	.083
27551	*J. A. Notkin & Bro., New Haven*	*20*	*12*	*0.651*	*19.75*	*.172*	*.167*
27685	Starr Bros., New London	15	12	1.238	4.98	.078	.083
27704	*Smith Pharmacy, Norwich*	*25*	*12*	*1.312*	*4.03*	*.068*	*.083*

MAGNESIUM CARBONATE.

(*Magnesii Corbonas.*)

"Magnesium carbonate should yield, upon ignition, not less than 40 per cent. of residue, of which not less than 96 per cent. should consist of pure magnesium oxide."

One grain should not contain more than 0.001 gm. of foreign soluble salts. It should not contain more than mere traces of lime, iron or other heavy metals.

Magnesium carbonate of a quality not strictly satisfying U. S. P. requirements is frequently sold marked "For technical use." The difficulty and expense of completely removing certain foreign salts greatly increases the cost of the substance, still as long as the U. S. P. is our standard for drug purity the druggist should adhere to that standard for the drugs he sells. Should the dealer sell this drug in the original package plainly marked "For technical use," he can hardly be criticized for selling an impure article, for he sells it for what it is. However, when selling the "technical" grade in bulk it should be so labeled as to give the purchaser full knowledge of its inferior quality.

Nine of the eighteen samples analyzed came in their original wrappers, and seven of these were branded "technical." One

sample each of Pattison's, Lehn & Fink's and all the bulk samples were sold as "Magnesium Carbonate" and should have met the U. S. P. requirements.

One sample, **27713**, proved to be oxide, not carbonate of magnesia. The other seventeen samples on ignition gave residues from 40.78 to 42.03 per cent., and contained from 38.88 to 40.52 per cent. of pure magnesium oxide, all satisfying the U. S. P. standards in both respects. All the samples, however, contained considerable foreign soluble salts, ranging from 0.62 to 1.07 per cent. Iron was found in traces or more in all samples, while lime was found in three samples.

While all the samples contained the proper amounts of the important ingredient, magnesium oxide, none of them was strictly in conformity with the rather exacting U. S. P. requirements.

Some of the samples showed quite a shortage in weight. Four ounces were asked for in every case, but the amounts delivered ranged from 3.3 to 4.4 ounces. Seven samples were short by 0.4 of an ounce or over, equivalent to 10 per cent. or more. The price ranged from 10 to 20 cents.

SOLUTION OF MAGNESIUM CITRATE.

(Liquor Magnesii Citratis.)

The U. S. P. formula for this preparation yields a product which contains, in 100 cc. of the solution, 1.60 gms. magnesium oxide, 0.33 gm. potassium oxide, 9.28 gms. total citric acid and 3.24 gms. free citric acid.

Forty-three samples were analyzed, thirty-one of our own collection and twelve from the Dairy Commissioner. These showed a wide range in composition. The thirty-one samples contained from 3.50 to 10.50 gms. total and from 0.18 to 3.81 gms. free citric acid 100 cc., from 0.72 to 1.91 gms. magnesium oxide, and from none at all to 0.40 gm. potassium oxide. All the samples contained traces of lime, ten from 0.05 to 0.11 gm. Twenty-nine showed strong, one slight and one no effervescence on opening. A lemon odor was strong in twenty-one samples, slight in five, and none detected in five. In twenty-five samples the solution was clear, in five slightly turbid and in one distinctly turbid. In all the samples there was some sediment;

TABLE XXIV.—MAGNESIUM CARBONATE.

Brand, or Place of Sale.	Weight. Claimed.	Weight. Found.	Cost per 4 oz. (claimed).	Residue on Ignition.	Magnesium Oxide.	Foreign Soluble Salts.	Impurities Detecte
	oz.	oz.	cts.				
*Keasbey & Mattison Co., Ambler, Pa.	4.0	4.2	20	41.53	39.60	0.78	Iron.
*Keasbey & Mattison Co., Ambler, Pa.	4.0	3.3	15	42.03	40.52	0.62	Traces lime and i
*Keasbey & Mattison Co., Ambler, Pa.	4.0	3.4	15	40.79	39.49	0.80	Iron and trace l
**Keasbey & Mattison Co., Ambler, Pa.*	4.0	4.0	15	40.78	38.88	1.04	Iron.
*Keasbey & Mattison Co., Ambler, Pa.	4.0	3.7	15	41.34	39.70	0.61	Iron.
Lehn & Fink, New York	4.0	3.7	20	41.07	39.29	0.93	Iron.
*Schieffelin & Co., New York	4.0	3.4	15	41.17	39.60	0.86	Iron.
*Pattison's, Washington Chem. Co., Engl.	4.0	4.4	10	41.25	40.11	0.77	Trace iron.
*Pattison's, Washington Chem. Co., Engl.	4.0	3.6	15	41.35	40.00	0.69	Trace iron.
In bulk. Hartford	4.0	4.1	10	41.72	39.90	0.76	Trace iron.
" "	4.0	3.7	10	41.98	40.52	0.84	Trace iron.
" New Haven	4.0	3.6	10	41.05	39.60	1.07	Iron.
" "	4.0	3.7	15	41.64	39.90	0.68	Trace iron.
" "	*4.0*	*3.5*	*10*	*41.91*	*40.21*	*0.79*	*Iron.*
" New London	4.0	4.1	10	41.68	40.21	0.82	Trace iron.
" Norwich	4.0	3.5	10	96.93	93.93	0.80	Trace iron; oxide carbonate, magn
" Waterbury	4.0	3.7	10	41.58	40.01	0.78	Iron.
" "	4.0	3.7	10	41.74	39.80	0.67	Iron and lime.
Average (excluding 27713)	*4.0*	*3.8*	*13.2*	*41.45*	*39.84*	*0.79*	

* Labeled, "Technical."

in eight this was very slight, in thirteen slight, in seven considerable and in three very heavy.

This solution is liable to deteriorate in appearance on keeping even for a short time, losing its clear, bright appearance and a precipitate of potassium bicarbonate frequently settling out. Furthermore, from its composition it is a particularly favorable medium for bacterial and fungus growth. For these reasons it should be made up in small lots only sufficient for immediate demands, or as directed in the U. S. P. "This preparation should be freshly made when wanted." It does not seem that age should impair its strength in magnesia and potash, but long keeping results in loss of acidity and carbonic acid gas, with an accom-

	Place of Sale.	Price per bottle.	Citric Acid. Total.	Citric Acid. Free.	Magnesium Oxide.	Potassium Oxide.	Calcium Oxide.	Effervescence.	Lemon Odor.	Appearance of Solution.	Character of Sediment.
		cts.									
27505	Bridgeport	20	8.19	2.28	1.68	0.35	Tr.	Yes	Yes	Clear	Slight.
27506	Bridgeport	25	9.42	3.26	1.71	0.36	Tr.	Yes	No	Clear	Slight.
27507	Bridgeport	25	7.98	2.56	1.52	0.36	Tr.	Yes	Slight	Clear	Very slight.
27508	Bridgeport	20	7.77	1.88	1.70	0.35	Tr.	Yes	Yes	Clear	Slight.
27633	Danbury	25	3.50	0.84	0.72	0.36	Tr.	Yes	Yes	Turbid	Slight.
27634	Danbury	25	7.63	2.59	1.38	0.30	Tr.	Yes	Slight	Clear	Very slight.
27715	Hartford	25	5.88	0.18	1.50	0.36	0.06	Yes	Yes	Clear	Heavy, lumpy.
27716	Hartford	20	6.79	2.45	1.10	0.32	Tr.	Yes	Yes	Clear	Slight.
27717	Hartford	20	7.84	2.68	1.38	0.38	0.05	Yes	Yes	Clear	Considerable.
27718	Hartford	25	7.21	2.34	1.25	0.35	Tr.	Yes	No	Clear	Considerable.
27583	Meriden	25	10.50	3.81	1.91	0.00	....	No	Yes	Clear	Considerable.
27584	Meriden	25	10.50	3.38	1.90	0.34	0.07	Yes	Yes	Clear	Slight.
27559	New Britain	25	5.95	1.30	1.35	0.24	Tr.	Yes	Yes	Clear	Very slight.
27560	New Britain	25	8.26	2.27	1.68	0.26	0.07	Yes	Yes	Clear	Considerable.
26950	New Haven	25	8.68	2.73	1.56	0.36	Tr.	Yes	Yes	Sl. turbid	Slight.
26951	New Haven	25	6.76	1.40	1.56	0.34	Tr.	Yes	Yes	Clear	Heavy.
26952	New Haven	20	5.50	1.98	0.97	0.38	Tr.	Yes	Yes	Clear	Very slight.
26953	New Haven	25	4.97	0.91	1.07	0.33	Tr.	Yes	Yes	Sl. turbid	Slight.
27552	New Haven	25	7.49	3.68	1.04	0.38	Tr.	Yes	Yes	Clear	Very slight.
27553	New Haven	25	8.54	2.66	1.61	0.35	Tr.	Yes	No	Clear	Slight.
27670	New London	25	5.60	1.88	0.97	0.39	Tr.	Yes	Yes	Clear	Very slight.
27671	New London	25	8.89	3.08	1.58	0.31	Tr.	Yes	Slight	Sl. turbid	Considerable.
27687	Norwich	25	6.30	1.41	1.42	0.36	Tr.	Yes	Slight	Sl. turbid	Heavy.
27688	Norwich	25	9.10	3.17	1.48	0.35	0.09	Yes	Yes	Sl. turbid	Slight.
27595	Stamford	25	7.28	1.44	1.55	0.37	0.06	Yes	Yes	Clear	Slight.
27596	Stamford	25	7.56	1.86	1.56	0.29	Tr.	Yes	Yes	Clear	Very slight.
27754	Waterbury	25	6.37	1.44	1.29	0.28	0.05	Yes	No	Clear	Considerable.
27755	Waterbury	25	8.12	2.56	1.57	0.40	Tr.	Slight	No	Clear	Considerable.
27756	Waterbury	25	5.53	1.37	1.07	0.36	0.07	Yes	Yes	Clear	Very slight.
[illegible]	Waterbury	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

panying precipitation of potassium bicarbonate, which seriously affects its appearance, if not its efficacy.

Total citric acid ranged from 3.50 to 10.50 gms. per 100 cc.

7 contained	*from 8.4*	*to 10.5 gms.,*	*or 90*	*to 113*	*per cent.*	U. S. P.
10 contained	from 7.4	to 8.3 gms.,	or 80	to 89	per cent.	U. S. P.
6 contained	from 6.4	to 7.3 gms.,	or 70	to 79	per cent.	U. S. P.
8 contained	from 3.5	to 6.3 gms.,	or 38	to 68	per cent.	U. S. P.

Free citric acid ranged from 0.18 to 3.81 gms.

6 contained	from 2.9	to 3.8 gms.,	or 90	to 117	per cent.	U. S. P.
7 contained	from 2.5	to 2.8 gms.,	or 77	to 86	per cent.	U. S. P.
4 contained	from 2.1	to 2.4 gms.,	or 65	to 74	per cent.	U. S. P.
14 contained	from 0.2	to 2.0 gms.,	or 6	to 62	per cent.	U. S. P.

Magnesium oxide ranged from 0.72 to 1.91 gms.

17 contained	*from 1.44*	*to 1.91 gms.,*	*or 90*	*to 119*	per *cent.*	U. S. P.
5 contained	from 1.28	to 1.43 gms.,	or 80	to 89	per cent.	U. S. P.
2 contained	from 1.12	to 1.27 gms.,	or 70	to 79	per cent.	U. S. P.
6 contained	from 0.96	to 1.11 gms.,	or 60	to 69	per cent.	U. S. P.
1 contained	0.72	gm.,	or 45		per cent.	U. S. P.

Potassium oxide ranged from none to 0.40 gm.

26 contained	from 0.30	to 0.40 gm.,	or 90	to 121	per cent.	U. S. P.
3 contained	from 0.26	to 0.29 gm.,	or 80	to 89	per cent.	U. S. P.
1 contained	0.24	gm.,	or 73		per cent.	U. S. P.
1 contained	*0.00*	gm.,	or *0*		per cent.	U. S. P.

Allowing a variation of ten per cent. from the U. S. P. standard, that is, 8.35 total and 2.92 free citric acid, 1.44 magnesia and 0.30 gm. potash per 100 cc., the following table summarizes our analyses:—

4 samples within 10 per cent. U. S. P.
2 samples low in free citric acid.
1 sample low in potash.
8 samples low in total and free citric acid.
1 sample low in total citric acid and magnesia.
11 samples low in total and free citric acid and magnesia.
2 samples low in total and free citric acid and potash.
2 samples low in all four ingredients.

That is, only four samples were entirely satisfactory, while twenty-four were deficient in total citric acid, twenty-five in free citric acid, fourteen in magnesia and five in potash. Sample

27583, otherwise of full U. S. P. strength, contained no potash whatever. The above results indicate that this solution was quite carelessly prepared by druggists, especially with respect to the citric acid and magnesia; also that in a number of instances the druggists dispensed stock not freshly prepared as is required by the U. S. P.

TABLE XXVI.—SOLUTION OF CITRATE OF MAGNESIA (DAIRY COMMISSIONER'S SAMPLES).

(Grams per 100 cc.)

Sample No.	Corresponding to Station Sample No.	Dealer.	Magnesium oxide.	Potassium oxide.	Per cent. U. S. P. strength.	
					MgO.	K_2O.
*5210	.....	S. N. Rubin, Hartford	0.86	0.19	54	58
6366	26953	J. A. Caryl, New Haven	1.73	0.33	108	100
6369	26952	Goldberg's Pharmacy, New Haven	0.94	0.23	59	70
6382	27670	Nichols & Harris, New London	1.12	0.39	70	118
6386	27687	West Side Drug Store, Norwich	1.25	0.36	78	109
6559	27583	V. W. Schmelzer, Meriden	1.71	0.38	107	115
6564	27717	J. M. Rosenthal, Hartford	1.07	0.38	67	115
6568	27559	Chas. Scherp, New Britain	1.43	0.26	89	79
†6583	27758	E. M. Roberts, Waterbury	1.72	0.48	108	145
6587	27756	Henry Picarelli, Waterbury	1.24	0.38	78	115
6588	27754	J. A. Urba, Waterbury	1.26	0.26	79	79
6598	27633	Doran's Drug Store, Danbury	1.76	0.31	110	94

* Contained 4.64 per cent. total and 1.06 free citric acid.
† Heavy precipitate of potassium bicarbonate present.

With one exception the twelve samples analyzed for the Dairy Commissioner were taken from drug stores where a short time before we had purchased substandard samples of this preparation. In these samples, except **5210**, only magnesia and potash were determined. **5210** proved to be only slightly over 50 per cent. U. S. P. strength, there apparently being little effort made to follow the formula. Of the other eleven samples four were within 10 per cent. of the U. S. P. standard, four were deficient in magnesia, one in potash, and two in both of these ingredients. In only three cases do the analyses of these second samples agree satisfactorily with those of our own sampling. This indicates either that the druggists do not always follow a definite formula, or that they are careless in compounding their solutions,

or that, knowing from the purchase of the three samples as required by law the reason for the purchase, they doctor the solution as the occasion may require. This we know to be the case in at least one of these samples. The station's sample certainly more fairly represents what the average purchaser receives.

Methods of Analysis.

Note the appearance of the sample as regards clearness, color, odor, amount of precipitation, etc. On opening note effervescence and gas presssure. Shake the sample thoroughly and empty into a large beaker. To hasten discharge of free carbonic acid pour rapidly from one beaker to another until effervescence ceases. Return liquid to the original container, shaking thoroughly each time before removing portions for analysis. Express results of analysis in grams per 100 cc.

Acidity (free or uncombined, excluding carbonic acid). Heat 25 cc. of solution to boiling in a porcelain casserole to remove last traces of carbonic acid and dilute to 50 cc. Titrate with half-normal sodium hydroxide solution, using phenolphthalein as indicator, and expressing the result as citric acid.

Total Citric Acid. Dilute 5 cc. of solution to 25 cc., and precipitate with excess of basic lead acetate solution; filter, and wash with dilute alcohol until the filtrate gives but a slight reaction for lead. Remove precipitate from filter, suspend in hot water and pass a rapid stream of hydrogen sulphide through to precipitate the lead. Filter off the black lead sulphide and wash with hot water. Boil the filtrate to remove excess of hydrogen sulphide and after cooling make up to 250 cc. Titrate an aliquot of 50 cc., equal to 1 cc. of original solution, with tenth-normal sodium hydroxide solution, using phenolphthalein as indicator.

Iron, Alumina and Phosphoric Acid. Evaporate 25 cc. of solution to dryness and ignite residue. Dissolve this in dilute hydrochloric acid and filter. Precipitate iron, alumina and phosphoric acid with ammonia, wash, dry and weigh.

Lime. Precipitate the filtrate from the preceding with ammonium oxalate and weigh as calcium oxide.

Magnesia. Evaporate filtrate from lime determination, remove ammonium salts by ignition and precipitate the magnesia with sodic phosphate, weighing as magnesium pyrophosphate. If only traces of iron, alumina, phosphoric acid and lime are present, the magnesia may be rapidly determined by evaporating 10 cc. of the solution, igniting the residue and dissolving same in hydrochloric acid, from which the magnesia may be precipitated directly by adding sodic phosphate and ammonia, weighing as the pyrophosphate.

Potash. Evaporate 25 cc. of solution, char residue and extract with hot dilute hydrochloric acid. Cool filtrate and make up to 100 cc. Evaporate an aliquot of 25 cc. to dryness in a platinum dish, and determine potash as in the Lindo-Gladding method.

OPIUM.

The U. S. P. standard for gum opium is not less than 9 per cent. of crystallized morphine, and for powdered opium not less than 12 per cent. nor more than 12.5 per cent. of crystallized morphine, when assayed by the U. S. P. method.

One sample of the gum and five of powdered opium were analyzed. The gum contained 11.3 per cent. of morphine and the powdered samples from 13.0 to 13.9 per cent. Two samples bore no poison label.

Morphine was determined by Eaton's method (Bur. of Chem., Bull. 137, p. 189).

TABLE XXVII.—OPIUM (GUM AND POWDERED.)

Station No.	Place of Sale	Cost per oz.	Weight sold for 1 oz.	Morphine.
	Gum.	cts.	oz.	per cent.
27531	Bridgeport	100	1.0	11.3
	Powdered.			
27745	*Hartford	85	0.8	13.4
27751	New Haven	85	1.0	13.7
27680	New London	100	0.9	13.9
27706	Norwich	100	0.9	13.8
27785	*Waterbury	85	0.8	13.0
	Average of powdered opium	*91*	*0.9*	*13.6*

* Not labeled poison.

PAREGORIC.

(Tinctura Opii Camphorata.)

A preparation of camphorated tincture of opium, more commonly known as paregoric, was made in the laboratory strictly according to the U. S. P. formula. This analyzed as follows:—

Specific gravity at 15.5° C.	0.9511
Alcohol by volume	45.65
Morphine gms. per 100 cc.	0.0524
Morphine grains per fluid ounce	0.240

Table XXVIII.—Paregoric.

Station No.	Place of Sale.	Cost per 4 oz., cts.	Specific gravity at 15.5° C.	Alcohol by volume.	Morphine: Grams per 100 cc.	Morphine: Grains per fluidounce.	Per cent. of Minimum *U.S.P. strength.*
	Laboratory Sample........	....	.9511	45.65	.0524	.240	105.3
27504	Bridgeport	20	.9525	......	.0480	.222	97.4
27522	"	25	.9585	......	.0552	.255	111.8
27523	"	25	.9536	......	.0468	.216	94.7
27524	"	25	.9564	......	.0492	.227	100.0
27525	"	20	.9499	......	.0504	.233	102.2
27624	Danbury	35	.9510	......	.0456	.210	92.1
27626	"	35	.9263	52.15	.0516	.238	104.4
27631	"	35	.9530	......	.0504	.233	102.2
27719	Hartford	25	.9410	48.39	.0504	.233	102.2
27720	"	20	.9688	40.94	.0492	.227	100.0
27721	"	25	.9511	......	.0504	.233	102.2
27722	"	20	.9490	......	.0444	.205	89.9
27730	"	15	.9541	......	.0480	.222	97.4
27578	Meriden	25	.9460	......	.0528	.242	106.1
27579	"	25	.9500	......	.0528	.242	106.1
27580	"	25	.9519	......	.0444	.205	89.9
27561	New Britain...............	35	.9519	......	.0510	.235	103.1
27562	"	20	.9559	......	.0504	.233	102.2
26955	New Haven	25	.9533	......	.0420	.194	85.1
26956	"	20	.9510	......	.0480	.222	97.4
26957	"	20	.9547	......	.0345	.159	69.7
26958	"	20	.9561	......	.0528	.242	106.1
27540	"	20	.9455	......	.0480	.222	97.4
27541	"	20	.9500	......	.0456	.210	92.1
27542	"	20	.9522	......	.0504	.233	102.2
27543	"	20	.9550	......	.0552	.255	111.8
27544	"	20	.9269	56.37	.0528	.242	106.1
27655	New London	35	.9522	......	.0504	.233	102.2
27679	"	30	.9500	......	.0390	.180	78.9
27696	Norwich	25	.9513	......	.0480	.222	97.4
27697	"	30	.9529	......	.0504	.233	202.2
27698	"	25	.9555	......	.0552	.255	111.8
27707	"	25	.9507	......	.0645	.298	130.7
27593	Stamford.................	20	.9511	......	.0432	.199	87.8
27594	"	20	.9555	......	.0450	.208	91.2
27762	Waterbury	15	.9469	......	.0391	.180	78.9
27763	"	25	.9563	......	.0492	.227	100.0
27764	"	35	.9483	......	.0480	.222	97.4
27765	"	25	.9515	......	.0552	.255	111.8
	Average	*24.4*	*.9510*	......	*.0489*	*.226*	*99.1*

This proved to be somewhat stronger in morphine than the U. S. P. minimum, or 105.3 per cent.

Thirty-nine samples were analyzed. Alcohol was determined only in those samples in which the specific gravity varied materially from that of the laboratory sample. In these four samples the alcohol ranged from 40.94 to 56.37, the gravities ranging inversely from 0.9688 to 0.9263.

The specific gravities of all the samples ranged from 0.9263 to 0.9688, average 0.9510.

Morphine ranged from 0.0345 to 0.0645 gms. per 100 cc. or from 0.159 to 0.255 grains per fluidounce, equivalent to 69.7 to 111.8 per cent. of minimum U. S. P. strength. The morphine content may be summarized as follows:—

19 from .0494 to .0645 gms. per 100 cc., or .228-.298 grs. per fl. oz., or 100-131 per cent. min. U. S. P.

13 from .0445 to .0493 gms. per 100 cc., or .206-.227 grs. per fl. oz., or 90-99 per cent. min. U. S. P.

4 from .0395 to .0444 gms. per 100 cc., or .182-.205 grs. per fl. oz., or 80-89 per cent. min. U. S. P.

3 from .0345 to 0.394 gms. per 100 cc., or .159-.181 grs. per fl. oz., or 70-79 per cent. min. U. S. P.

The inspection showed paregoric to be in a very satisfactory condition, 19 samples equaling or exceeding U. S. P. strength, 13 being deficient by less than 10 per cent., and only 7 by more than 10 per cent. The weakest sample was only 70 per cent. minimum U. S. P. strength, while one was 131 per cent. U. S. P.; this latter sample appears to be dangerously strong.

Thirty-five samples were of the normal yellow-brown color. **26957**, the weakest of all, was light yellow in color; **27544** was brown and **27719** and **27722** were dark brown, the latter being labeled "Elixir Paregoric" and stated to contain licorice. In **27544** and **27719** the abnormality in color was not associated with a deficiency in morphin.

This much-used preparation ranged in price from 15 to 35 cents for four ounces of samples of equivalent strength.

Methods of Analysis.

Morphine. The method used was based on that suggested by Eaton (Bur. of Chem., Bull. *137*, p. 189), with, as seemed to us, some useful modifications. Evaporate 100 or 50 cc. of paregoric to about 15 cc. and transfer to separatory funnel. After washing out with ether as directed, the sample was transferred to a 100 cc. flask, made up to the mark with

lime water, shaken, and allowed to stand for one hour. 50 cc. of this filtered solution was introduced into a separatory funnel and shaken out three times with chloroform, 15 cc. each, and then with 25 cc. of washed ether. (Repeated tests of the ether wash gave a negative test with Mayer's reagent, showing washing once with ether was sufficient for paregoric.) Collect ether-chloroform extractions in another separatory funnel and wash with 10 cc. of limewater; return limewater to original solution and reject the immiscible solvent. To the solution now add 20 cc. of alcohol and then 10 cc. of one per cent. ammonium chloride solution to free the morphine, testing with wet litmus paper held in the neck of the funnel. Follow with 30 cc. of chloroform and shake thoroughly for several minutes. Draw off and shake with four successive 30 cc. portions of a mixture of one part alcohol and four chloroform. Filter the combined alcohol-chloroform extracts, after washing with 10 cc. of water, through a filter wet with chloroform into a 250 cc. pressure flask, removing the chloroform and alcohol by distillation under diminished pressure. (In this way all but about 10 cc. of the solvent may be recovered.) Evaporate the undistilled portion at room temperature in a bell jar using a current of filtered air. When dry add 5 cc. of absolute alcohol and allow to stand until complete solution is effected. Then dissolve in 5 cc. of fiftieth-normal sulphuric acid and titrate with fiftieth-normal potassium hydroxide, using cochineal as indicator.

SODIUM SALICYLATE.

(Sodii Salicylas.)

Sodium salicylate should contain not less than 99.5 per cent. of the pure salt. Its aqueous solution should be colorless and should have only a slightly acid reaction. It should be free from sulphates, sulphites, chlorides and heavy metals.

Thirteen samples were analyzed. These contained from 96.0 to 98.4 per cent. sodium salicylate. One gave a colorless aqueous solution, one pinkish and eleven a slight brown color. Eight gave slightly acid and five distinctly acid reactions. No sulphates were found in nine samples, traces in two, and considerable in two. No sulphites were found in five samples, traces in six, and considerable in two. No chlorides were found in ten samples, and traces in three. No heavy metals were found in four samples, and traces in nine.

No glaring adulteration was detected in any of the samples, although all samples were somewhat below full U. S. P. strength; in three samples the deficiency amounting to as much as four per cent.

The same tendency towards short-weight, so often observed in purchases from druggists, was shown with this drug. Although one ounce was asked for in every case, the amount delivered ranged from 0.8 to 1.2 oz., only three samples giving the full weight, and five showing a deficiency of 20 per cent.

The U. S. P. methods of analysis were used.

TABLE XXIX.—SODIUM SALICYLATE.

Place of Sale.	Cost per oz.	Weight sold for 1 oz.	Sodium Salicylate	Color of Aqueous Solution.	Reaction.	Sulphates.	Sulphites.	Chlorides.	Heavy Metals
	cts.	oz.							
Danbury	10	0.8	98.4	sl. brown	sl. acid	No	No	No	Tra
Hartford	*10*	*0.9*	*96.0*	*sl. brown*	*dist. acid*	*Trace*	*Trace*	*Trace*	N
Hartford	10	0.8	97.6	sl. brown	dist. acid	Trace	Trace	No	N
Meriden.......	10	0.8	97.6	colorless	dist. acid	No	No	No	Tra
New Britain ...	10	0.9	98.4	sl. brown	sl. acid	No	Trace	No	Tra
New Haven ...	10	0.9	97.6	sl. brown	sl. acid	No	No	No	Tra
New Haven ...	*10*	*1.2*	*98.4*	*sl. brown*	*sl. acid*	*No*	*No*	*Trace*	Tra
New London ..	10	1.1	98.4	sl. brown	sl. acid	No	Trace	No	Tra
*Norwich.......	15	1.0	97.6	sl. brown	sl. acid	Yes	Yes	Trace	N
Stamford	10	0.8	98.4	sl. brown	dist. acid	No	No	No	Tra
Waterbury.....	15	0.9	96.0	pinkish	dist. acid	Yes	Yes	No	N
Waterbury.....	10	0.8	96.0	sl. brown	sl. acid	No	Trace	No	Tra
Waterbury.....	10	0.9	96.8	sl. brown	sl. acid	No	Trace	No	Tra
Average.....	*10.8*	*0.9*	*97.5*	....	....	.....	.....	.....	...

* Powers & Weightman, Philadelphia.

PRECIPITATED SULPHUR.

(*Sulphur Præcipitatum.*)

Precipitated sulphur is prepared by boiling sublimed sulphur and lime in water, then precipitating the sulphur from the clear solution by means of hydrochloric acid, and finally washing the precipitate with water until no further reaction for lime is given. This precipitate when dried contains the sulphur in a very finely divided state, rendering it more readily suspended in liquids and increasing its value in the making of ointments. The use of sulphuric acid is not admissible, as thereby the sparingly soluble calcium sulphate is formed instead of the easily soluble calcium chloride. The nature of the frequent adulteration of this material indicates either that sulphuric has been substituted for hydro-

chloric acid, that the precipitate has been insufficiently washed. or that there has been a direct addition of sulphate of lime to the finished product. It was rather surprising that when the station agent sought to buy precipitated sulphur, several of the druggists seemed unfamiliar with the existence of such a preparation.

U. S. P. precipitated sulphur should not leave a weighable residue on ignition, or on evaporating its ammoniacal solution. It should contain not less than 99.5 per cent. of pure sulphur and should have a neutral reaction.

Fifteen samples were analyzed. Although precipitated sulphur was asked for in each case, in three samples the labeling was simply "Sulphur."

TABLE XXX.—PRECIPITATED SULPHUR—PASSED.

Station No.	Place of Sale.	Weight. Claimed.	Weight. Found.	Price of sample.	Residue on ignition.	Residue on evaporation of ammoniacal solution.	Reaction.	Lime (CaO).	Sulphuric anhydride (SO_3).
		oz.	oz.	cts.					
27502	Bridgeport..........	2	1.7	5	0.34	0.17	Neutral.	...	...
27735	Hartford	2	2.2	5	0.45	0.27	"	...	...
27736	* "	2	3.6	5	0.05	0.00	"	...	...
27573	Meriden.............	2	2.7	10	0.06	0.07	"	...	...
27571	New Britain.........	2	1.8	10	0.36	0.37	"	...	...
27496	New Haven.........	2	1.8	10	0.56	0.50	"	...	...
27663	* "	Box.	3.4	5	0.09	0.00	"	...	...
27683	New London........	2	1.9	5	0.07	0.00	"	...	...
27703	Norwich............	2	1.9	5	0.30	0.20	"	...	...
27782	*Waterbury.........	2	2.1	10	0.11	0.20	Acid.	...	...
27783	"	2	1.9	5	0.34	0.10	Neutral.	...	...
27784	"	2	1.9	10	0.32	0.30	"	...	...

* Labeled "Sulphur."

TABLE XXXI.—PRECIPITATED SULPHUR—ADULTERATED.

27737	Hartford............	2	1.9	5	46.46	2.07	Neutral.	19.09	27.16
27549	New Haven.........	2	1.9	10	3.47	1.77	"	0.96	1.93
27753	New Haven.........	2	2.0	5	46.19	1.73	"	18.94	26.89

All the samples showed some residue on ignition. In twelve of these this residue ranged from 0.05 to 0.56 per cent.; in the other three the residues were 3.47, 46.19 and 46.46 per cent. respectively. The residue from evaporating the ammoniacal

solution in twelve samples ranged from none to 0.50 per cent.; in the three, showing large residues on ignition, 1.73, 1.77 and 2.07 per cent., respectively. In one sample the reaction was acid, in all the others neutral.

Three samples showed gross adulteration with sulphate of lime. These contained 19.09, 0.96 and 18.94 per cent. of lime and 27.16, 1.93 and 26.89 per cent. of sulphuric anhydride, respectively.

The usual variations in weight sold were shown by these samples. From 1.7 to 3.4 ozs. were delivered in response to a request for 2 ozs., at a cost ranging from 5 to 10 cents.

The three samples found to be adulterated were reported to the Dairy Commissioner and second samples were purchased by him. **6335** and **6337**, bought of H. Morris and Charles S. Leete, New Haven, contained 0.38 and 0.24 per cent. of ash, respectively, although the station's samples contained 3.47 and 46.19 per cent. the third sample, **6850**, from Goldfield Bros., Hartford, contained only 0.03 per cent. ash against 46.46 per cent. obtained in the first sample; this sample, however, was not precipitated sulphur, but ground brimstone.

The results secured with these three samples again illustrates the futility of the present method of buying three samples. The dealer is at once put on his guard, and the purchase often does not represent the same quality of material sold to the general consumer. In the case of one of these samples, after the sample was purchased and the dealer recognized the purpose of the purchase, he declared the sample was not U. S. P.

TURPENTINE.

At the 1911 session of the General Assembly an act (Chapter 274, Public Acts of 1911) concerning the adulteration of turpentine was passed. Section 1 of this act provides that

"No person, firm, or corporation shall manufacture, mix for sale, offer or expose for sale, or have in his or its possession with intent to sell, or sell, under the name of turpentine or spirits of turpentine, any article which is not wholly distilled from rosin, turpentine gum, or scrapings from pine trees, and unmixed and unadulterated with oil, benzine, or any other substance of any kind whatsoever, unless the package containing the same shall be stenciled or marked with letters not less than two inches high and one inch wide 'adulterated spirits of turpentine.' Nothing herein contained shall be construed as prohibiting

the manufacture or sale of any such compound or imitation, provided the package containing the same shall be plainly marked as such."

Turpentine had never been systematically inspected in this State. Acting, therefore, under the authority of the above law, the Dairy Commissioner, through his agents, collected 130 samples, which were analyzed in this laboratory, and are herewith reported. The samples were taken chiefly from the stock of dealers in painters' supplies.

Turpentine as sold in this country is of two general varieties, that distilled from gum turpentine and that distilled from cut pine, fir or spruce, known as "wood" or "stump" turpentine. When properly refined the latter closely resembles gum turpentine. Objection has been raised to its use, however, because of its odor, its physiological effect, its lack of uniformity and unsatisfactory working qualities. It is believed, however, that improved manufacturing processes will in the near future render this product satisfactory commercially and thus utilize the vast stumpage waste in the South. In the present examination no attempt has been made to identify wood turpentine in distinction from that distilled from the gum.

American turpentine is frequently adulterated with cheaper, inferior oils, generally petroleum oils corresponding closely in specific gravity and temperature of distillation with turpentine. Certain coal-tar oils, rosin spirits and wood turpentine are also sometimes used as adulterants.

The Bureau of Chemistry, U. S. Dept. of Agriculture, has suggested specifications for three grades of commercial turpentine (Bull. *135*, p. 25) as follows:

Standard or No. 1, spec. grav. at 20° C. from 0.862-0.870; refractive index at 20° C. from 1.468 to 1.476; 95 per cent. should distill below 170° C.; on polymerization the residue should not exceed 1 per cent., should be reddish in color and viscous, and its refractive index at 20° C. should be from 1.500 to 1.520.

Second quality or No. 2, spec. grav. at 20° C. from 0.862-0.875; refractive index at 20° C. from 1.468 to 1.480; 90 per cent. should distill below 170° C.; the polymerization residue must not exceed 1 per cent. and must have a refractive index of not less that 1.500.

Third quality or No. 3, spec. grav. at 20° C. from 0.865-0.880; refractive index at 20° C. from 1.468 to 1.485; 60 per cent. should distill below 170° C.; the polymerization residue must not exceed 1 per cent. and must have a refractive index of not less than 1.500.

Coste gives similar specifications for pure turpentine, though varying slightly in some details (Analyst, *33*, 220).

Specific gravity at 15.5° C. from 0.860 to 0.871; refractive index at 20° C. from 1.469 to 1.472; should yield no distillate below 155° C., not less than 70 per cent. between 155° and 160° C., and not less than 95 per cent. up to 180° C.; no part of the distillate should refract below *pinene, 1.4652.*

Walker gives still other specifications, which likewise show minor variations from those first cited (Bur. of Chem., Bull. *109*, p. 14).

Specific gravity at 15.5° C. from 0.862 to 0.875; refractive index at 20° C. from 1.469 to 1.474; initial distillation about 156° C., 95 per cent. distilling over between 153.5° and 165.5° C. Six cc. of turpentine (by the method indicated) should show not less than 0.3 cc. unpolymerized oil after thirty minutes and not less than 0.5 cc. after eighteen hours.

In order to simplify the tables the refractive index is expressed in degrees of the butyro-refractometer, 63.2 and 76.0 corresponding to refractive indices of 1.468 and 1.476, respectively. The methods used require no special comment; the polymerization method employed was that given by Walker (Bur. of Chem., Bull. *109*, p. 14), the foam test was that quoted by many authorities, in which a persistence of foam after violent shaking indicates the presence of mineral oil, and the Klein potassium iodide test was likewise a test for mineral oil.

The results of analysis are shown in two tables, first (Table XXXII), those which gave specific gravities between 0.858 and 0.883 at 15.5° C., and refractive indices between 62.0° and 73.8°, which are passed as "not found adulterated," and second (Table XXXIII), those which were found to contain mineral oil or water, or were otherwise below standard.

Eighty-five samples were not found adulterated, although doubtless some of these were in part, if not wholly, wood turpentine. These ranged in color from water-white to yellowish. Nine of the samples gave the foam test, but further examination revealed the presence of no appreciable amount of mineral oil.

The specific gravity at 15.5° C. ranged from 0.858 to 0.883, corresponding to 0.861 to 0.886 at 20° C. The following groups may be formed, based on specific gravity:

17 samples between 0.858 and 0.867
54 samples between 0.868 and 0.872
11 samples between 0.873 and 0.877
3 samples between 0.878 and 0.883

In other words, based on this determination alone only 17 of the samples would meet the U. S. specifications for standard No. 1 turpentine, 71 those for second quality, 11 others those for third quality, while three others showed gravities higher than either of the three U. S. grades.

The refractive index ranged from 62.0° and 73.8°, eighty between 62.0° and 69.5°, and five between 70.0° and 73.8°. These values would satisfy the requirements of any of the three U. S. grades.

Twenty of the samples gave more or less pronounced reactions for mineral oil by the Klein test. The specific gravities and refractive indices of these samples, however, were so nearly normal that the amount of mineral oil present must have been extremely small, and these samples are passed as not found adulterated.

Twelve of the passed samples were subjected to fractional distillation, in some cases to secure data from samples apparently pure, and in others because of doubts of their purity raised by other tests. In these the initial distillation temperature ranged from 155° to 161°, from 57 to 98 per cent. distilled under 165°, and from 85 to 98 per cent. under 175°. With the exception of **6141**, which by all the tests appeared to be wood turpentine, the distillation data on these samples were considered reasonably satisfactory. The refractive indices of the different fractions were likewise normal.

Adulterated and Substandard Samples.

In Table XXIII are given the analyses of forty-five samples, which are adulterated or otherwise of inferior quality. Thirty-four of these contained mineral oil in large amounts. four contained water, one mineral oil and water, and six were otherwise below standard grade.

Many of the samples were water-white in color, while others were yellowish and those containing water had a milky appearance. In nine samples, which other tests proved to contain from

TABLE XXXII.—TURPENTIN

Station Number.	Sold as	Dealer.
141	Turpentine	*New Milford:* C. M. Beach..................................
401	"	*South Norwalk:* C. E. Dowe ....
402	"	Fox Cycle and Hardware Co. ....
403	"	*Norwalk:* H. F. Prowitt..................................
404	"	Hubbell Staples..................................
406	"	*Meriden:* Wm. S. Bailey..................................
408	"	John F. Butler ....
410	"	*Middletown:* C. A. Pelton..................................
411	"	Wm. Greaves ....
416	"	*New Haven:* The F. E. Spencer Co..................................
417	"	*Hartford:* Bonner Preston Co..................................
419	"	Hoffman Wall Paper Co..................................
420	"	Sisson Drug Co..................................
421	"	American Wall Paper and Paint Co..................
422	"	Wadsworth Howland Co..................................
424	"	C. H. Talcott & Co..................................
425	"	C. R. Turner ....
428	"	Sisson Drug Co..................................
429	"	*Meriden:* Little, Somers & Hyatt Co..................................
430	"	Grimord Bros. ....
431	"	Birdsey & Raven ....
432	"	*Wallingford:* The J. R. Burghoff Co..................................
434	"	Dickerman Hardware and Supply Co.............
435	"	*New Britain:* The John Boyle Co. ....
439	"	Morgan & Kingsley ....
440	"	E. U. Thompson ....
441	"	*Greenwich:* Jaynes Hardware Co. ....
442	"	Greenwich Hardware Co. ....
443	"	D. K. Allen ....
444	"	*Stamford:* Warshow's Paint and W. P. Co. ....
445	"	J. S. Davenport & Sons ....
446	"	Lockwood & Palmer..................................
449	"	*Willimantic:* A. B. Holmes..................................
450	"	Latham & Crane ....
451	"	*Rockville:* N. Wendheiser..................................
452	"	Geo. W. Hill ....
453	"	*Danbury:* Danbury Hardware Co..................................
456	"	R. R. Wildman ....
460	"	*Winsted:* G. W. Kilmer ....
462	"	J. F. Denison & Son ....
463	"	*Torrington:* James Smith's Son ....
464	"	J. F. Baldauf ....
466	"	*Ansonia:* T. P. Terry & Son ....
467	"	Estate Lockwood & Hotchkiss..................................
468	"	Frank Yudkin ....

OT FOUND ADULTERATED.

Color and Appearance.	Foam Test.	Klein Potassium Iodide Test.	Specific gravity at 15.5° C.	Temperature of Initial Distillation. ° C.	Percentage distilling.				Butyro-refractometer at 20° C.			
					Under 155° C.	155° to 165° C.	165° to 175° C.	175° to 180° C.	Original Material.	Fraction under 155° C.	Fraction 155° to 165° C.	Fraction 165° to 175° C.
Yellowish	Yes	No	.880	161	..	57	28	..	67.2	...	62.5	65.4
Colorless	No	"	.871	...	..	..	..	..	65.7	...	...	...
"	"	"	.871	157	..	92	6	..	67.0	...	65.0	69.9
"	"	"	.872	157	..	87	8[1]	..	66.1	...	64.0	68.1[1]
"	"	"	.871	158	..	98	..	..	66.1	...	65.7	...
Sl. yellow	"	"	.871	...	..	..	..	..	64.5	...	...	...
"	"	"	.870	...	..	..	..	..	65.1	...	...	...
Colorless	"	"	.874	...	..	..	..	..	67.3	...	...	...
White, sl. cloudy	Yes	"	.873	...	..	..	..	..	66.5	...	...	...
Colorless	No	"	.873	...	..	..	..	..	68.1	...	...	...
"	"	Faint pink	.870	...	..	..	..	..	66.1	...	...	...
"	"	Pink brown	.870	...	..	..	..	..	65.7	...	...	...
"	"	"	.872	...	..	..	..	..	68.0	...	...	...
Cloudy, yellowish	"	No	.870	...	..	..	..	..	66.1	...	...	...
Bluish	"	Pink brown	.871	...	..	..	..	..	67.0	...	...	...
Colorless	"	"	.872	...	..	..	..	..	67.0	...	...	...
Yellowish	Yes	No	.883	157	..	76	13[1]	..	70.2	...	64.3	68.1
Colorless, sl. cloudy	No	"	.871	...	..	..	..	..	67.0	...	...	...
White, cloudy	"	"	.873	...	..	..	..	..	68.4	...	...	...
Yellowish, cloudy	"	Yellow	.865	...	..	..	..	..	63.7	...	...	...
Colorless	"	Pink brown	.871	...	..	..	..	..	67.0	...	...	...
"	"	"	.873	...	..	..	..	..	66.7	...	...	...
Yellowish, cloudy	"	Yellowish	.873	...	..	..	..	..	68.0	...	...	...
Colorless	"	Pink brown	.871	...	..	..	..	..	69.1	...	...	...
"	"	"	.872	...	..	..	..	..	65.3	...	...	...
White, cloudy,	"	"	.871	...	..	..	..	..	66.1	...	...	...
Colorless	"	No	.872	...	..	..	..	..	68.0	...	...	...
Yellowish	"	"	.871	...	..	..	..	..	67.0	...	...	...
"	"	"	.870	...	..	..	..	..	73.8	...	...	...
Colorless	Slight	"	.870	...	..	..	..	..	66.1	...	...	...
Yellowish, cloudy	No	"	.872	...	..	..	..	..	67.0	...	...	...
Colorless	"	"	.871	...	..	..	..	..	67.3	...	...	...
"	"	Sl. pink	.871	...	..	..	..	..	67.0	...	...	...
"	"	No	.872	...	..	..	..	..	68.0	...	...	...
"	"	"	.863	157	..	68	20	..	61.1	...	60.9	62.0
"	"	"	.871	...	..	..	..	..	67.2	...	...	...
White, cloudy	"	"	.875	...	..	..	..	..	67.2	...	...	...
Yellowish	Slight	"	.872	...	..	..	..	..	65.9	...	...	...
Colorless	No	"	.863	...	..	..	..	..	65.0	...	...	...
Yellowish	"	"	.870	...	..	..	..	..	66.1	...	...	...
Yellowish, dirty	"	Yellowish	.870	...	..	..	..	..	66.1	...	...	...
White, cloudy	Yes	No	.867	...	..	..	..	..	64.0	...	...	...
Colorless	No	Faint yellow	.870	...	..	..	..	..	68.0	...	...	...
"	"	"	.870	...	..	..	..	..	67.0	...	...	...
"	"	No	.870	...	..	..	..	..	65.0	...	...	...

TABLE XXXII.—TURPENT

Station No.	Sold as	Dealer.
6470	Turpentine	*Derby:* F. Hallock Co.
6471	"	Abbott & Co.
6472	"	Edw. Watkins
6473	"	*Shelton:* N. D. Clark
6474	"	*Naugatuck:* J. M. Page & Co.
6475	"	Geo. W. Benedict
6476	"	*Seymour:* Seymour Lumber and Hardware Co.
6478	"	*Bridgeport:* Hawley Hardware Co.
6481	"	Frank M. West
6483	"	Samuel Dawe
6484	"	James J. Conlin
6485	"	H. D. Murphy
6486	"	Somers Bros.
6487	"	Senior Bros.
6489	"	Harry Rider
6490	"	L. B. Silliman
6491	"	Hubbell & Wade Co.
6492	"	*Waterbury:* Apothecaries Hall Co.
6493	"	Austin & Woodruff Co.
6494	"	" " "
6496	"	Hotchkiss & Templeton
6497	"	Siglaski Marks Co.
6498	"	*Putnam:* Chandler & Morse
6500	"	Ballard & Clark
6501	"	H. S. Burt
6509	"	*Norwich:* The Eaton Chase Co.
6512	"	Fred C. Crowell
6513	"	T. H. Eldredge
6515	"	The Chas. Osgood Co.
6517	"	Lee & Osgood Co.
6518	"	*New London:* Lyon & Ewald
6519	"	Walter A. Smith & Co.
6522	"	The G. M. Williams Co.
6524	"	Darrow & Comstock
6525	"	New London Decorating Co.
6527	"	*New Haven:* Thompson & Belden
5528	"	Lightbourn & Pond Co.
6529	"	H. M. Hodges
6531	"	Wm. H. Sellwood
6532	"	John Foley

18 to 89 per cent. of mineral oil, the foam test gave negative results. Likewise in seven samples known to contain mineral oil, the Klein test failed to reveal it.

NOT FOUND ADULTERATED.—*Continued.*

Color and Appearance.	Foam Test.	Klein Potassium Iodide Test.	Specific gravity at 15.5° C.	Temperature of Initial Distillation. °C.	Percentage distilling. Under 155° C.	155 to 165° C.	165° to 175° C.	175° to 180° C.	Butyro-refractometer at 20° C. Original Material.	*Fraction under 155° C.*	Fraction 155° to 165 C.	Fraction 165° to 175° C.
Colorless	No	No	.871	...	..	..	..	..	68.0	...	...	...
"	"	Faint pink	.870	...	..	..	..	..	67.0	...	...	...
White, cloudy	"	No	.868	...	..	..	..	..	67.0	...	...	...
Colorless	"	Faint pink	.868	...	..	..	..	..	67.0	...	...	...
"	"	No	.869	...	..	..	..	..	68.0	...	...	...
Yellowish, fluorescent	"	Yellowish	.871	158	..	85	8[1]	..	68.0	...	64.8	68.1
"	"	"	.868	159	..	84	12	..	70.0	...	66.2	70.3
Colorless	"	No	.870	...	..	..	..	..	68.0	...	...	...
"	"	"	.868	...	..	..	..	..	67.0	...	...	...
"	"	"	.871	...	..	..	..	..	70.0	...	...	...
Yellowish, cloudy	"	Sl. pink	.870	...	..	..	..	..	68.0	...	...	...
Colorless	"	"	.868	...	..	..	..	..	66.4	...	...	...
White, cloudy	"	"	.869	...	..	..	..	..	67.5	...	...	...
"	"	No	.860	155	..	88	6[1]	..	62.0	...	58.8	61.7
Colorless	"	Sl. pink	.867	...	..	..	..	..	64.5	...	...	...
"	Yes	Red'sh brown	.864	...	..	..	..	..	65.0	...	...	...
Colorless, dirty	No	Sl. pink	.858	157	..	85	10[1]	..	62.0	...	58.8	61.8
Colorless	"	No	.868	...	..	..	..	..	68.1	...	...	...
White, cloudy	"	Sl. pink	.866	...	..	..	..	..	65.9	...	...	...
Colorless	"	No	.867	...	..	..	..	..	68.0	...	...	...
Colorless, dirty	"	"	.869	...	..	..	..	..	67.0	...	...	...
Colorless	"	"	.869	...	..	..	..	..	68.0	...	...	...
"	"	......	.873	...	..	..	..	..	69.8	...	...	...
"	"	......	.868	...	..	..	..	..	67.6	...	...	...
"	"	......	.867	...	..	..	..	..	67.0	...	...	...
"	"	......	.867	...	..	..	..	..	65.3	...	...	...
"	"	......	.867	...	..	..	..	..	66.0	...	...	...
Sl. color	Yes	......	.879	...	..	..	..	..	68.0	...	...	...
Colorless	No	......	.868	...	..	..	..	..	66.4	...	...	...
"	"	......	.872	...	..	..	..	..	65.0	...	...	...
Cloudy	"	......	.873	...	..	..	..	..	68.0	...	...	...
Colorless	"	......	.873	...	..	..	..	..	67.0	...	...	...
Sl. cloudy	"	......	.870	...	..	..	..	..	68.0	...	...	...
Colorless	"	......	.867	...	..	..	..	..	65.0	...	...	...
"	Slight	......	.873	...	..	..	..	..	68.0	...	...	...
"	No	......	.867	...	..	..	..	..	66.1	...	...	...
"	"	......	.869	...	..	..	..	..	66.6	...	...	...
Sl. cloudy	"	......	.863	155	..	79	16	..	63.2	...	62.0	68.[illegible]
Colorless	"	......	.872	...	..	..	..	..	67.0	...	...	...
"	"	......	.865	158	..	78	18	..	64.0	...	63.5	67.[illegible]

[1] Fraction 165°–170° C.

In the detection of mineral oil the chief dependence was placed on specific gravity, refractive index, initial distillation tempera-

TABLE XXX

Sample No.	Sold as	Dealer.	Color a Appearar
07	Turpentine	*Meriden:* The J. Lacourciere Co	White, cl
09	"	Ivers Bros	"
12	"	*Middletown:* L. O. & E. S. Davis	"
15	Turpeen	*New Haven:* L. L. Rosenberg	Yellow
18	2d Run Turpentine	*Hartford:* H. Harris Co	Colorl
23	Turpentine	J. S. White Sons	Yellow
33	"	*Wallingford:* W. A. Butler	Colorle
36	"	*New Britain:* Rackliffe Bros. Co	White, cl
37	"	W. Sanderson & Co	Colorle
38	Adult Turpentine	P. F. Kelley	"
47	Turpentine	*Willimantic:* Hurley Grant Co	"
48	"	H. R. Chappell	"
54	Commercial Turpentine	*Danbury:* Geo. F. Hawley	"
55	Turpentine	F. A. Hull & Son	"
57	"	F. C. Lawrence	Yellow
58	Turpeen	J. Wright & Co	Colorless,
59	Turpentine	Fred Quaas	White, cl
61	"	*Winsted:* Dickerman & Pond Co	Yellowish,
65	"	*Torrington:* Hotchkiss Bros. Co	Colorle
69	2d Run Turpentine	*Derby:* Louis Bennett	Yellow
77	Turpentine	*Seymour:* C. S. Lounsbury & Son	Colorle
79	"	*Bridgeport:* Coester Bros	"
80	"	Geremia & Cocozza	White, cl
82	"	Joseph Coughlin Co	Colorle
88	"	Edw. J. Brooks	"
95	"	*Waterbury:* Wilson & Savin	Yellowish,
99	"	*Putnam:* J. O. Fox & Co	"
02	"	*Danielson:* Woodward Drug Store	Colorle
03	"	The Burrows Drug Co	"
04	"	*Moosup:* C. D. Salisbury	"
05	Turpeen	W. W. Rood	Slightly cl
06	Turpentine	*Plainfield:* Dearnley & Clark	Colorle
07	"	*Norwich:* Preston Bros	"
08	Substitute Turpentine	Albert Boardman	"
0	Turpentine	Peck, McWilliams & Co	Yellow
1	"	P. F. Murbagh	Colorle
4	"	S. W. Carroll & Son	"
6	"	H. Blackledge & Co	"
0	"	*New London:* H. E. Hanson	Slightly cl
1	Adult. Turpentine	R. J. Sisk	Colorle
3	Turpentine	Eaton & Wilson	"
6	"	Hobson & Root	"
0	"	*New Haven:* Wadsworth & Howland	"
3	"	E. M. Walsh Co	Slightly cl
4	"	S. G. Grillo	Colorle

[A]DULTERATED TURPENTINE.

Klein Potassium Iodide Test.	Specific gravity at 15.5° C.	Temperature of Initial Distillation °C.	Percentage distilling. Under 155° C.	155° to 165° C.	165° to 175° C.	175° to 180° C.	Butyro-refractometer at 20° C. Original material.	Fraction under 155° C.	Fraction 155° to 165° C.	Fraction 165° to 175° C.	Fraction 175° to 180° C.	Unpolymerized Percentage.	Butyro-refractometer at 20° C.	Color
No	.865	..	..	..	..	..	61.2	..	..	..	..	..	..	.....
"	.865	..	..	..	..	..	62.3	..	..	..	..	..	..	.....
"	.835	−142	45[2]	46	..	..	42.1	25.6	58.9	..	..	27	26.6	Colorl
Pinkish red	.822	150	23	27	18	..	29.0	17.1	20.6	26.1	..	88	24.5	"
"	.817	158	..	22	22	10	34.0	..	17.4	22.9	28.1	82	30.3	"
No	.857	−142	24	43	..	..	56.9	31.6	54.6		..	22	56.4	Pinki
Pink	.799	145	34	24	16	..	25.6	15.9	20.5	25.9	..	91	22.9	Colorl
No	.856	154	9	50	22	..	57.1	37.2	52.8	58.3	..	..	..	.....
"	.850	152	7	67	..	..	55.0	44.0	52.8	..	..	..	..	.....
Red	.828	−142	6	11	12	..	35.0	10.6	13.6	21.1	..	92	35.0	Colorl
No	.847	−142	39	54	..	..	53.1	42.4	60.2	..	..	18	22.0	"
Pinkish red	.844	154	6	64	..	..	51.0	40.6	48.6	..	..	41	51.8	Pinki
"	.815	145	26	34	..	..	34.0	22.9	29.9	..	..	..	..	.....
No	.859	−142	25	56	..	..	57.1	37.2	57.9	..	..	16	60.3	Sl. pi
"	.856	−142	17	46	15[1]	..	59.7	37.7	56.0	63.2[1]	..	21	63.1	Colorl
Yellowish brown	.823	−142	11	16	40[1]	..	34.0	14.2	19.3	26.6[1]	..	82	30.1	"
No	.858	−142	16	39	18[1]	..	60.9	36.5	54.6	61.8[1]	..	25	63.0	Sl. pi
Slightly yellow	.865	155	..	68	17[1]	..	62.9	..	60.0	63.1[1]	..	17	67.3	"
Yellowish	.814	160	..	13	21[1]	31[3]	34.0	..	27.3	30.1	33.3	54	20.6	Colorl
Pinkish red	.828	150	4	14	18	..	38.7	18.8	20.9	26.7	..	78	36.8	"
No	.868	155	..	64	22	..	60.0	..	57.7	59.2	..	18	56.4	"
"	.847	155	..	77	12	..	56.0	..	51.1	57.4	..	38	66.8	Sl. pi
Slightly yellow	.831	155	..	18	15	9	39.7	..	19.8	27.9	33.2	77	37.0	Colorl
No	.856	150	14	34	29	..	60.0	38.1	53.1	60.2	..	26	56.3	Pink
Slightly pink	.841	152	8	65	14[1]	..	50.0	40.1	47.3	53.1	..	42	57.0	Sl. pi
Yellowish	.791	151	10	34	28	..	19.2	9.5	12.2	17.4	..	83	13.2	Colorl
....	.860	155	..	41	35	7	60.0	..	55.0	60.0	61.2	..	..	.....
....	.852	155	..	37	34	8	55.4	..	50.0	55.3	57.0	..	..	.....
....	.837	−153	8	67	8	6	47.0	38.2	45.4	48.0	48.5	44	49.0	Colorl
....	.857	155	..	59	25	4	58.0	..	55.4	59.0	59.0	..	..	.....
....	.825	148	9	9	13	5	36.5	11.7	15.2	21.2	26.0	91	34.8	Colorl
....	.838	153	5	61	27	..	47.4	39.0	45.3	50.4	..	47	53.5	"
....	.833	155	..	17	24	8	42.5	..	30.0	36.3	40.7	66	38.8	"
....	.834	158	..	35	39	7	45.0	..	39.0	42.4	44.0	33	36.0	"
....	.873	142	8	21	23	9	59.0	28.0	42.2	50.0	54.4	46	56.0	Pinki
....	.857	154	3	29	35	9	56.0	42.3	48.0	53.0	55.0	..	..	.....
....	.810	146	20	21	19	7	31.7	16.2	20.8	26.4	31.0	89	30.1	Colorl
....	.843	−142	32[4]	59	7	..	53.3	27.4	60.4	71.0	..	26	63.2	Browni
....	.856	156	..	56	28	..	57.0	..	54.0	57.8	..	..	..	.....
....	.802	145	28	29	18	5	28.5	19.0	24.0	30.0	34.8	83	24.6	Colorl
....	.871	145	6	13	17	9	40.5	20.3	24.2	30.2	35.3	77	37.8	"
....	.826	155	..	17	17	9	38.0	..	20.0	26.4	31.0	81	36.0	"
....	.848	155	..	75	18	..	54.8	..	52.5	59.0	..	32	67.8	Brown
....	.844	−142	42	54	..	..	53.0	32.5	60.0	..	..	28	59.0	"
....	.821	150	7	13	17	9	33.0	11.2	16.3	23.0	28.0	88	32.8	Colorl

Fraction 165°–170° C. [2] 22% distilled under 145° C.
Fraction 170°–180° C. [4] 21% distilled under 140° C., refractometer, 10.3.

ture, fractions distilling at different temperatures, the refractive indices of these fractions and the amount and appearance of the unpolymerized oil.

Samples Adulterated with Mineral Oil.

Specific gravity ranged from 0.791 to 0.873, thirty of the samples showing less than 0.858.

The temperature of initial distillation ranged from below 142° to 160°, nine distilling under 142° and thirty-one under 156°. The fractions distilling at the different temperatures were very variable, from none to 42 per cent. under 155°, from 17 to 96 per cent. under 165°, from 29 to 98 under 175°; in one sample 21 per cent. distilled under 150°.

The refractive index of the original turpentine ranged from 19.2° to 60.9°. The refractive indices of the different fractions increased with the temperature of distillation. The indices of the fractions under 155° ranged from 9.5° to 44.0°, 155°—165° from 12.2° to 60.4°, 165°—175° from 17.4° to 71.0°, 175°—180° from 26.0° to 55.0°.

Based on the amount of unpolymerized oil the percentage of mineral oil ranged from 16 to 92 per cent., fourteen containing over 75 per cent. The refractive index of the unpolymerized oil ranged from 13.2° to 67.8°. This oil was generally colorless or faint pink and had the characteristic odor of mineral oil.

Samples Adulterated with Water.

In these four samples the turpentine had a milky appearance; the specific gravity ranged from 0.856 to 0.865 and the refractive index from 57.1° to 62.3°.

Samples Below Standard.

In these six samples the specific gravity ranged from 0.847 to 0.868, the temperature of initial distillation from 155° to 156°, from 37 to 77 per cent. distilled under 165° and from 71 to 89 per cent. under 175°. The refractive index of the original turpentine ranged from 55.4° to 60.0° while that of the fractions ranged from 50.0° to 61.2°. In two of these samples there were indications of the presence of a certain amount of mineral oil, but the evidence was contradictory, and they are simply classed as substandard samples.

Summary.

Of 130 samples analyzed 85 were passed as not found adulterated. Seventeen of these meet the U. S. specifications for No. 1 turpentine, 71 those for No. 2, and 11 those for No. 3; three samples showed higher gravities than permitted for any of these three grades.

Forty-five samples were adulterated or below standard, 34 with mineral oil from 16 to 92 per cent., four with water, one with mineral oil and water, while six others were below standard.

Of the adulterated samples 36 were sold as turpentine, 3 as turpeen, 2 as second run turpentine, 2 as "adulterated" turpentine and one each as substitute and commercial turpentine. The samples of turpeen, second run and "adulterated" turpentine were somewhat similar in composition and contained from 78 to 92 per cent. of mineral oil.

The manufacturers and jobbers represented in the present inspection, as far as known, were as follows, the samples found not to be pure turpentine being indicated by heavy type:

American Naval Stores Co., New York, 6406, 6416, 6421, 6428, 6492; Apothecaries Hall Co., Waterbury, 6466, 6474, 6476; Barclay Naval Stores Co., 6408, 6419, 6424, 6442, 6444, **6459**, 6472, 6473, 6478; J. W. Barry, Boston, **6412**, 6417, **6423**, **6436**, **6447**, **6455**, 6509, **6516**, **6533**; Booth & Law, New Haven, **6409**, 6430, **6458**, 6460, 6468, 6532, **6534**; A. G. Belden & Co., New York, 6402, 6403, 6445; O. T. Bourne Co., Savannah, Ga., 6497; Brewer & Co., Worcester, Mass., 6500; Carolina Pine Products Co., Cleveland, O., **6510**; Carpenter & Morton Co., Boston, 6475, 6518; John A. Casey & Co., New York, 6401, 6404, 6425, 6432, 6434, 6441, 6446, 6449, 6453, 6471, 6481, 6483, 6494, 6496, 6501, 6519, 6522, **6523**, 6527, 6528; E. C. Church, Providence, R. I., **6504**; L. O. & E. S. Davis, Middletown, 6411; Devoe & Raynolds, New York, 6435; J. R. Ells, Southport, **6457**, **6465**; Gulf Turpentine Co., Cleveland, O., **6508**; H. S. Hawley, Danbury, 6456; H. M. Hodges & Bro., New Haven, **6433**; Hubbell & Wade Co., Bridgeport, 6487; Independent Turpentine Co., New York, 6443; Jackson Varnish Co., Chicago, **6438**; J. T. Kirk, New York, 6489; Longman & Martinez, 6141; Loos & Dilworth, Philadelphia, **6479**, **6488**, **6507**, 6512, 6513, 6515, 6517, **6521**, 6524, **6530**; Lee & Osgood Co., Norwich, **6448**, **6502**, **6503**; David B. Levy, New York, **6454**, **6526**; Chas. Osgood Co., Norwich, **6499**; Penn Alcohol and Chemical Co., Philadelphia, 6429, 6431, 6450; M. W. Sarendon, New York, 6490; Sherwin-Williams Co., Newark, N. J., 6525; Siglatski & Briggs, Hartford, 6437, 6462; L. B. Silliman, Bridgeport, 6467, 6485; Sisson Drug Co., Hartford, 6439; Southern States Turp. Co., **6418**, **6469**, 6493, **6514**, **6520**; T. E. Spencer, 6531; Thompson & Belden, New Haven, 6440, 6451, 6463, 6464, 6477, 6484; Tolar, Hart & Co., 6410, 6452; U. S. Turpentine Co., 6491; Weaver Co., Providence, R. I., **6480**, **6505**.

PROPRIETARY REMEDIES.

A number of these remedies were examined with sufficient completeness to make a fair judgment of their medicinal value and the claims made for them. It is well-known that, even when the claimed ingredients are present, as a rule the purchaser pays an exorbitant price for remedies of more or less well-known efficacy.

Hydrozone.

27511. *Hydrozone, 30 Vol.* H_2O_2, Charles Marchand, New York. This is simply a proprietary name for a preparation of hydrogen dioxide, supposed to be of unusual excellence and strength. The capacity of the bottle was 58 cc., but it contained only 13 cc. of the liquid. The cork was apparently tight, but the condition of the advertising matter surrounding the bottle indicated possible leakage. Hydrogen dioxide deteriorates rapidly unless handled and stored with the greatest care and it would be expected that with a solution as strong as this one claimed to be deterioration would be even more rapid. This sample contained only 0.68 per cent. of dioxide, less than one-fourth the strength of the ordinary U. S. P. Solution of Hydrogen Peroxide, in spite of its claim to be three times stronger. It is interesting to note that in 1909 this Station analyzed a sample of the regular hydrogen dioxide put out by this same firm, which contained only 0.63 per cent. (Report for 1909, pt. ii, 264).

In order to be entirely fair another sample of Hydrozone, **1455**, was purchased and analyzed. The contents of the bottle practically reached the mark noted by the manufacturer as indicating proper volume, and there was no indication of any leakage whatever. This new sample, however, contained only 2.99 per cent. of dioxide, that is, the strength of the ordinary U. S. P. solution. It is quite probable that Hydrozone, when it leaves the manufacturer's hands, is of the strength claimed. It is evident, however, at least in the two examples examined by us, that because of the liability of hydrogen dioxide to deteriorate, especially when in concentrated form, the purchaser of Hydrozone can have little assurance he is receiving the superior article he expects. Any medicinal preparation of the nature of Hydrozone, which, because of the casual method of purchase of proprietary

medicines, may have been on the druggist's shelf for months or possibly longer, must necessarily be an uncertain purchase.

Gouraud Oriental Cream.

27536. *Oriental Cream or Magical Beautifier for the Skin and Complexion,* Ferd. T. Hopkins, successor to T. Felix Gouraud. Capacity of bottle, 8 fl. ozs.; cost, 98 cents.

Specific gravity at 15.5°, 1.0457; specific gravity of liquid portion, 0.99989; solids per 100 cc., 5.35 gms., all of which is mercurous chloride (calomel); no mercuric chloride (corrosive sublimate) present.

The preparation consisted of about 13 gms. of calomel suspended in 8 fl. ozs. (240 cc.) of water. The amount of calomel in the bottle of this substance can be bought at retail for about 6 cents., the remaining 92 cts. is the charge for a half-pint of water. Calomel, while generally used internally, is often used externally "as an efficient alterative and desiccant in venereal and other ulcers, herpetic eruptions, etc." (U. S. Dispensatory, 19th Ed., p. 626.)

Spiro Powder.

27557. *Spiro Powder,* Spiro Company, Niagara Falls, N. Y. "It will prevent and destroy the odors of perspiration on the body, feet and clothing, relieve eczema, chafing and prickly heat, ease sore feet and reduce inflammation." Weight of sample, 20 gms.; cost, 25 cents. A very fine, light, white powder, with a mild, agreeable odor of oil of roses.

It contained 99.55 per cent. of ash, and showed no further loss on heating at 100° C. *Qualitative tests showed zinc to be the only metal* present, and no mineral or organic acids; 99.96 per cent. of zinc oxide found. On distillation with steam a clear distillate was obtained with the odor of roses; phenol and thymol absent. On heating under a watch glass, cooled in ice water, a very minute sublimate appeared in fine, tree-like crystals, which were not identified; it did not respond to the general tests for phenols; boric acid absent.

The preparation appears to be essentially zinc oxide, with possibly a trace (not over 0.50 per cent.) of zinc carbonate, and an odoriferous material similar to oil of roses.

Zinc oxide is sometimes employed "as an exsiccant to excoriated surfaces and in various skin diseases, sometimes by sprinkling

on the affected part, but generally in the form of ointment. . . . As a cosmetic it has the great advantage over the preparations of lead of not being poisonous." (U. S. Dispensatory, 19th Ed., p. 1355.) Chemically pure zinc oxide may be bought for 35 cents per pound, while the commercial oxide costs but 15 cents per pound; the amount of zinc oxide in this preparation could be bought in the purest form for 1.5 cents.

Poslam.

26946. *Poslam,* Emergency Laboratories, New York. "The new discovery for Eczema and all other skin troubles." The sample was sold in a small tin and weighed 20.5 gms., and cost 50 cents. A grayish ointment with a strong, tarry odor.

31.84 per cent. was insoluble in chloroform, and contained salicylic acid, 11.47 per cent. of zinc oxide, and 19.45 per cent. of anhydrous corn starch. Another portion of the chloroform-insoluble residue yielded a small amount of salicylic acid. The aqueous extract from the shake-out gave a test for zinc, indicating that probably some zinc salicylate had been formed by the action of the zinc oxide and salicylic acid.

The chloroform-soluble portion of the ointment on evaporation showed bright yellow crystals, like sulphur. Sulphur determined by the method of Puckner and Hilpert (Rept. of Chem. Lab., Amer. Med. Asso., *2*, p. 26) amounted to 6.55 per cent.

The fatty portion, after removal of the tar oil, on distillation with steam gave a distillate having a slight odor of menthol; the aqueous liquid remaining in the distillation flask responded to tests for salicylic acid.

On extracting a portion of the chloroform extract with 95 per cent. alcohol, a residue of 14.40 per cent. was obtained; this was of a dark brown color and had a tarry odor. The fatty portion, after extracting the tar oil, was not identified, but was probably petrolatum. (See Puckner and Hilpert, *loc. cit.*)

A summary of the analysis follows:

Zinc oxide	11.47
Sulphur	6.55
Starch, anhydrous	19.45
Tar oil	14.40
Menthol	present
Salicylic acid	present

Fatty base, probably petrolatum, sufficient to make 100 parts.

The analysis shows that the preparation derives its therapeutic value from zinc oxide, tar oil and sulphur. "These have long

been used and known as more or less effectual remedies for the treatment of skin affections, but certainly do not warrant such claims as are made in the advertising matter sent out with Poslam stating it to be 'The newest medical discovery for the treatment of eczema, and all other skin affections' and ' . . . entirely different from anything yet used.'" (Puckner and Hilpert, *loc. cit.*) Even the larger sized jars put out by the company, holding 5.5 ozs. and costing $2.00, would cost the purchaser about $5.80 per pound, for materials not worth more than 17 cents at retail prices.

Dr. Franck's Grains of Health.

26947. *Genuine Doctor Franck's Grains of Health, Laxative Pills,* A. Rougureff, Paris, France. Number of pills, 49; weight, 5.33 gms.; cost, 39 cents. The pills were packed in a small box with shreds of cork, and were coated with a silvery substance.

1.78 per cent. ash was found, which showed qualitatively the presence of silver, sodium and iron, 0.91 per cent. of metallic silver being obtained. 12.29 per cent. of the pills was insoluble in 95 per cent. alcohol. The alcohol-soluble portion, on evaporation to dryness, gave a bright, shiny brown mass, yellow in thin layers, and tasting strongly of aloes. On dissolving in hot water and treating with a strong solution of sodium borate, a very pronounced greenish fluorescence appeared, indicating aloes in large amount; no alkaloids were detected. 25.90 per cent. of the pills was insoluble in water. Neither salicylic acid, benzoic acid nor phenolphthalein was present.

The pills appear to be essentially aloes coated with silver, and cost at the rate of $33.19 per pound.

Dr. Williams' Pink Pills for Pale People.

26954. *Dr. Williams' Pink Pills for Pale People,* The Dr. Williams Medicine Co., Schenectady, N. Y., and Brockville, Ont. "Safe and Effective Tonic for the Blood and Nerves. For Anæmia, Diseases due to Impoverished Blood, such as Rheumatism, Diseases of Women, Nervous Disorders resulting from Mal-Nutrition, including Neuralgia, Sciatica, St. Vitus' Dance. Useful in Locomotor Ataxia and Partial Paralysis. A digestive tonic for Dyspepsia and Chronic Constipation." The package contained 38 pills, weighing 12.75 gms., and costing 43 cents. The pink color of the pills was due to cochineal; the pill coating, consisting of sugar and calcium carbonate, made up 55 per cent. of the weight of the pill.

34.20 per cent. of the whole pills was insoluble in water; this residue dissolved in hydrochloric acid with effervescence (carbonates), a flocculent precipitate separating out. The aqueous solution gave a negative test for aloes, and contained no soluble iron, and no nitrates or phosphates; sulphates were present and a trace of chlorides. Iron was present in the hydrochloric acid solution. 22.19 per cent. of ash was found, showing much iron, lime, magnesium, carbonates and sulphates, and consisted chiefly of iron oxide, magnesium sulphate and calcium carbonate. 6.94 per cent. of iron oxide, 3.36 per cent. of sulphuric anhydride and 1.68 per cent. of magnesium oxide were found.

Phenolphthalein, benzoic acid and salicylic acid were not present. 97.81 per cent. of the pill mass was insoluble in 95 per cent. alcohol. The residue from the small soluble portion gave a negative reaction for aloes, and after proper treatment yielded a slight residue, which gave a very faint cloudiness with Mayer's reagent (trace of alkaloids), insufficient for identification.

A summary of the analysis follows:

Ash	22.19
Iron oxide	6.94
Sulphuric anhydride	3.36
Magnesium oxide	1.68
Insoluble in water	34.20
Pill mass insoluble in alcohol	97.81
Lime and carbonates	present
Alkaloids and chlorides	faint traces
Color	cochineal
Salicylic acid, benzoic acid, phenolphthalein and aloes	none

The active ingredients detected were iron oxide, and magnesium sulphate (Epsom salt), and a faint trace of alkaloids.

In spite of the claim that the pills are "Not a cure-all," we find that they are recommended for all diseases resulting from impoverished blood, a long list of female complaints, for many nervous disorders, such as St. Vitus' dance, paralysis and locomotor ataxia, and for male disorders arising from excesses, etc.; surely a rather wide field. In using the pills the patient is directed first to purge the bowels, then take the pills, bathe frequently, keep the bowels regular, and partake of a nutritious diet. The thought occurs that perhaps the desired result might as well be secured by *following all of this treatment except the taking of the pills.*

Kargon Compound.

[illegible]. *Kargon Compound,* Kargon Extracting Co., Cincinnati, O. "Contains 15 per cent. alcohol." Volume of bottle

31 cc.; cost, 39 cents. A rather heavy liquid, specific gravity at 15.5° C., 1.1644, of a brown color and a strong odor and tasting of buchu.

It contained 10.2 per cent. of alcohol by weight, or 15 per cent. by volume, and 18.1 per cent. of glycerine; total solids, 48.3 per cent.; ash 12.67 per cent., which gave qualitative tests for potassium and carbonates only. Five cc. of the substance distilled with phosphoric acid gave 0.6360 gm. of acetic acid, or 10.93 per cent. acetic acid, equivalent to 17.87 per cent. potassium acetate. (The 12.67 per cent. of potassium carbonate obtained in the ash was equivalent to 17.99 per cent. of potassium acetate.)

The analysis may be summarized as follows:

Specific gravity at 15.5° C.	1.1644
Alcohol by volume	15.0
Glycerine	18.1
Solids	48.3
Potassium acetate	17.87
Buchu	present

In other words, this remedy contains potassium acetate, glycerine, alcohol and buchu.

Kargon is one of those preparations whose advertisements often appear in our newspapers as solid reading matter, in which a harmless-looking prescription is given, consisting of Kargon Compound, Fluidextract of Dandelion and Compound Syrup of Sarsaparilla, with the ingenuous advice that they "can be procured from any good pharmacist and mixed at home." This prescription is evidently intended to lead the public to believe that Kargon is one of the numerous standard diuretics, but when one goes to buy it he finds that it is made by one and only one concern, a proprietary medicine in every sense of the word. Such a prescription as that given above of course yields an active diuretic. "But it is a combination that in the majority of cases of kidney disease will do great harm. And no matter what the condition, if used indiscriminately and 'taken regularly,' as the advertisements advocate, it cannot be otherwise than dangerous." (Jour. Amer. Med. Asso., Mch. 16, 1907, p. 967.)

"As an act of humanity kindly recommend this valuable mixture to your suffering relatives, friends or acquaintances, especially elderly people who may need this remedy," is advice which comes with each bottle, and which should be disregarded by every one having the slightest humanitarian instincts.

Schenck's Pulmonic Syrup.

27509. *Schenck's Pulmonic Syrup*, Dr. J. H. Schenck & Son, Philadelphia. "The 70 year old Standard Remedy for Consumption, Coughs, Colds, Diseases of the Lungs and Respiratory Organs." Volume of bottle, 11 fl. ozs., cost, 85 cents. A brown, syrupy fluid with a very sweet taste, and an odor of wintergreen and of an acetous character resembling vinegar.

Specific gravity at 15.5°, 1.3861. *It was miscible with water without* causing any precipitate. It had an acid reaction; lead acetate produced only a very slight turbidity in a 13 per cent. solution. On dilution with 95 per cent. alcohol a slight turbidity resulted. No alkaloids were present, and only 0.08 per cent. of ash. By treatment with Fehling's solution, 34.49 per cent. sucrose and 38.40 per cent. invert sugar, or 72.89 per cent. total sugars were obtained. The direct polarization at 24° C. was +26.4, after inversion —22.0.

Two gms. mixed with sand and dried to constant weight gave 75.59 per cent. solids.

Steam distillation gave a slight acid distillate with the odor of oil of wintergreen. The syrup shaken out with chloroform, after acidification, gave an oily residue of a wintergreen odor, with a reaction for salicylic acid, probably resulting from decomposition of oil of wintergreen.

The following is a summary of our analysis:

Specific gravity at 15.5°	1.3861
Alcohol	none
Glycerine	none
Solids	75.59
Sucrose	34.49
Invert Sugar	38.40
Ash	0.08
Oil of Wintergreen	present
Alkaloids	none

This remarkable remedy for consumption is essentially a wintergreen-flavored mixture of saccharine syrups, 96.4 per cent. of the solids consisting of sugars. It is hard to believe that the virtues of this material rests in the 2.7 per cent. of undetermined solids (possibly vinegar of squills). It is recognized that a rich and nutritious diet is essential in the treatment of consumption, and it is true that this substance with nearly 73 per cent. of sugar is highly nutritious, and yet one can scarcely recommend the purchase of such a preparation at the rate of $2.50 per quart, when molasses is obtainable at 50 to 60 cents per gallon.

Thialion.

27510. *Thialion,* a Non Effervescing Lithiated Laxative Salt, manufactured for The Voss Chemical Co., Danbury, Conn. Net weight, 4 ozs.; cost, 89 cents. A granular, gritty substance of a slightly brown color and with a salty taste; the addition of water caused no effervescence. Qualitative tests gave reactions for sulphates, chlorides, citrates, sodium and lithium.

The following determinations were made: chlorine, 1.94 per cent.; sulphuric anhydride, 15.51 per cent.; citric acid radical, 42.86 per cent.; lithium, 0.148 per cent., and total sodium, 25.84 per cent. Calculating the lithium as lithium citrate, the sulphate as sodium sulphate, the chlorine as sodium chloride, and the residual citric acid as sodium citrate we obtain the following probable composition of this material. (On heating at 100° C., a loss of only 0.28 per cent. was obtained; such water as the substance may contain exists therefore as water of crystallization, and this is estimated by difference.)

Sodium citrate	57.77
Sodium sulphate, anhydrous	27.53
Sodium chloride	3.20
Lithium citrate, anhydrous	1.48
Combined water (by difference)	10.02

In the literature sent to physicians and in its advertisements Thialion is stated to be "a laxative salt of lithia" of the following formula: "3 Li_2O, NaO, So_3, 7 HO," and sodio-trilithic anhydro-sulphate is given as its name. As our analysis shows, it is simply a mixture of sodium citrate and sodium sulphate with very small amounts of lithium citrate and sodium chloride. The advertising literature, therefore, deliberately misrepresents the facts, for we have here no new chemical compound that possesses any mysterious therapeutic properties different from those of its component drugs. Speaking of the graphic formula furnished by the makers of this preparation the Journal of the American Medical Association says, Nov. 3, 1906, p. 1500: "To a physician who possesses but little knowledge of chemistry, it will seem impressive, and he may absorb the idea that it stands for a preparation that is the result of exhaustive scientific research. To the chemist, this formula will appear as a jumble of symbols and numbers that mean nothing. It is not worth while to call attention to the simplicity of this simple mixture of ordinary salts, for it is too self-evident."

Ely's Liquid Cream Balm.

26945. *Ely's Liquid Cream Balm,* "Remedy for Catarrh, Catarrhal Deafness, Hay Fever, Cold in Head." Ely Brothers, New York. Volume of bottle, 50 cc.; cost (including glass inhaler), 69 cents. A pinkish liquid of a rather thick consistency, with the odor of thymol and menthol.

Specific gravity at 15.5° C., 0.8696; no alcohol, no glycerine, no ash, no cocaine or other alkaloids present. Five gms. of the liquid showed 4.1215 gms. of unsaponifiable residue, and 0.6435 gm. of fatty acids or allied substances, a total of 4.7650 gms., or 95.3 per cent. (The above separation was probably accompanied by some mechanical loss in purifying the two fractions.) The unsaponifiable residue had a decided odor of menthol. Ten cc. of the liquid treated with glacial acetic, sulphuric and nitric acids gave a green color, indicating presence of thymol. The colorless, oily layer left after removing thymol was insoluble in water and cold alcohol, but soluble in ether, petroleum ether, and chloroform; this residue had a specific gravity of 0.860, index of refraction at 20°, 1.4715; treatment with acetic anhydride (Lewkowitsch, *i*, p. 376) showed the presence of mixed hydrocarbons. All these properties indicated liquid petrolatum as the basic substance. The fatty acids had a refractive index at 20° of 1.4689, but were not identified; these may have been due to an admixture of fixed oils or to impurities in the petrolatum. The polarization in alcoholic solution was lævorotatory, a characteristic of menthol.

This preparation appears to consist essentially of liquid petrolatum with small quantities of thymol and menthol.

"Liquid petrolatum is much used as a soothing local application in inflammation of the mucous membrane in the nose, throat, larynx, and even bronchial tubes. It is usually applied by means of an atomizer." (U. S. Dispensatory, 19th Ed., p. 925.) The amount of this simple and well-known remedy, contained in a bottle of this preparation (50 cc.) is worth about one-half of a cent.

Cubanos.

27558. *Cubanos, a Positive Relief for Asthma and Catarrh.* Manufactured for Cubanos Cure Co., New York. "Contains the following ingredients, Poppy Heads, Sugars, Stramonium, Leaves of Belladonna, Root of Belladonna, Tincture of Benzoin, Nitrate of Potash, and Opium (one-tenth grain to one ounce of Cubanos)." Packages of two sizes bought, the 10 cent size weighing 11.82 gms., the 25 cent size, 31 gms.

A microscopical examination showed the presence of belladonna leaves tissues (wavy parenchyma of upper and lower epidermis, stomata, glandular hairs, collenchyma cells, and calcium oxalate "sand"); belladonna root and poppy head tissues (pitted cells of inner epidermis of fruit coat) also present. Stramonium tissues strongly resemble those of belladonna, making it difficult to distinguish them.

The material contained 22.02 per cent. of ash, 1.86 per cent. being insoluble in hydrochloric acid (sand). Qualitative tests in the ash showed the presence of carbonates, sulphates, phosphates, chlorides, nitrates, silicates, iron, aluminum, calcium, sodium and potassium, most of which, excepting the nitrates, silicates and part of the potash, were probably normal ingredients of the vegetable substances of the mixture. 2.50 per cent. of nitrate nitrogen was present, equivalent to 18.02 per cent. of potassium nitrate. Reducing sugars were present.

Ten grams of the material yielded .0285 gm. of crude alkaloidal residue, which on purification amounted to .0160 gm., or 0.16 per cent. Mayer's reagent gave a heavy precipitate; general reactions for opium bases were obtained as follows:—nitric acid gave a reddish yellow color, potassium ferricyanide and ferric chloride and trace of hydrochloric acid gave a blue color. No attempt was made to detect hyoscyamine and atropine in the small alkaloidal residue. No benzoin was detected.

The material appears to be essentially as claimed, but is somewhat expensive, the smaller packages costing at the rate of $3.84 per lb., the larger, $3.65 per lb.

Dr. Pierce's Golden Medical Discovery.

26939. *Dr. Pierce's Alterative Extract or Golden Medical Discovery.* World's Dispensary Medical Association, Buffalo, N. Y. Capacity of bottle, 10 fl. ozs.; cost, 79 cents. Claimed to contain Golden Seal Root, Queen's Root, Stone Root, Black Cherrybark, Bloodroot, Mandrake Root, chemically pure Glycerine, pure Water and a very small amount of Borate of Soda, "less than a grain to the dose of 'Discovery.'"

The following determinations were made:—specific gravity at 15.5° C., 1.1070; alcohol, none, glycerine, 27.60 per cent.; solids, 38.80 per cent.; ash, 0.69 per cent.; sodium borate, 0.65 per cent.; polarization at 23° C., zero before and after inversion; phenolphthalein, none; potassium iodide, none.

While it was impossible to determine the presence of the various alterative vegetable drugs claimed in this preparation, the

total amount of vegetable extractives found was 11.20 per cent., hardly entitling it to be called "a very concentrated, vegetable extract." The amount of sodium borate found was well within that claimed. The constituent drugs claimed to be present have a recognized therapeutic value, but hardly entitle it to the "cure-all" properties claimed for it in its advertising literature. That these well-known drugs by a mysterious combination, the result of "a tedious course of study and experiment, extending over several years," can become a "superior remedy" for coughs, bronchitis, laryngitis, weak lungs, sore throat, biliousness, dyspepsia, general debility, nervous prostration, blood diseases, skin diseases, catarrhal affections of all organs, heart diseases, malaria, constipation, kidney and bladder affections, etc., etc., is certainly a strain on one's credulity.

Peruna.

26944. *Peruna Tonic,* The Peruna Co., Columbus, O. "Contains eighteen per cent. of alcohol by volume." Capacity of bottle, 20 ozs.; cost, 75 cents. The main label on the bottle claims "Pe-Ru-Na contains cubebs, hydrastis canadensis, corydalis formosa, collinsonia canadensis, cedron seed, ginger, senna, glycerine and a very small proportion of the oil of copaiba." On a separate sticker is this naïve information:

"For a number of years requests have come to me from a multitude of grateful friends, urging that Peruna be given a slight laxative quality. I have been experimenting with a laxative addition for quite a length of time, and now feel gratified to announce to the friends of Peruna that I have incorporated such a quality in the medicine which, in my opinion, can only enhance its well-known beneficial character. S. B. Hartman, M.D."

A brown liquid, specific gravity at 15.5° C., 0.9870; alcohol by weight, 14.0 per cent., by volume, 17.37 per cent.; solids, 2.67, glycerine, 1.50, ash, 0.11 per cent; polarization direct and after inversion at 23°, ±0.0; phenolphthalein not present nor any inorganic laxative; positive tests for cubebs and senna.

The dealcoholized solution acidified and shaken out with ether and ether-acetone, then made alkaline with ammonia and shaken out with ether-chloroform gave a residue yielding a positive test with Mayer's reagent. Further tests in this residue gave results resembling those for prohibited alkaloids but it was found that these tests were due to senna and cubebs (declared on the label and otherwise identified). The

only reaction not accounted for by the presence of these two vegetable drugs was the faint reddish color obtained with nitric acid, but this test is insufficient in itself to prove the presence of morphine or its derivatives. The principles of senna and cubebs are largely removed by shaking out with ether-acetone from acid solution, but it was shown that this separation is incomplete, some of these principles appearing in the residue from the alkaline shake-out.

Analyses of Peruna, made before the passage of the Federal law, show from 22 to 26 per cent. alcohol by volume, and from 0.35 to 0.44 per cent. of solids. It was so clearly an alcoholic beverage and not a medicine that the Internal Revenue Commissioner required sellers of it to take out a liquor license, which explains the sticker quoted above. The "grateful friends" requesting the addition of a laxative were probably dealers who objected to paying a liquor tax, and the "laxative addition" with which Dr. Hartman experimented "for quite a length of time," as far as we can determine, is simply the well-known drug senna. The extract from vegetable drugs in Peruna is only about one per cent.

A. D. S. Rheumatic Remedy.

26948. *A. D. S. Rheumatic Remedy,* Premium Remedy for the relief of Rheumatism, Lumbago, Sciatica and Gout. "Contains 4 per cent. alcohol." American Druggists' Syndicate, New York, Distributors. *Capacity of bottle, 2.3 ozs.; cost, 50 cents.*

A brownish viscid liquid, specific gravity at 15.5°, 1.1015; alcohol by weight, 4.1 per cent., by volume, 5.7 per cent.; solids, 23.4 per cent.; glycerine, 9.80 per cent.; ash, 7.90 per cent. Qualitative tests in the ash showed carbonates, sodium, potassium, iodides and a trace of sulphates. 6.45 per cent. potassium iodide, 1.25 per cent. sodium oxide and 5.29 per cent. salicylic acid were found, the two latter being equivalent to 6.13 per cent. sodium salicylate (calculated from the salicylic acid determination). No phenolphthalein present. An acidified portion dealcoholized and shaken out with ether and ether-acetone, gave a negative test for senna; made alkaline with ammonia and shaken out with ether-chloroform a residue was obtained giving a positive test for alkaloids with Mayer's reagent. This residue gave a faintly reddish color with nitric acid, a blue color with ferric chloride and ferricyanide, and no violet color with sulphuric acid and formaldehyde. The blue color with ferricyanide is given by many vegetable extractives, e. g., colchicum, and the third test is negative for opium bases. The nitric acid test is not conclusive enough for the identification of morphine or its derivatives.

A *summary of the analysis follows:*

Specific gravity at 15.5° C.	1.1015
Alcohol by volume	5.70
Solids	23.40
Glycerine	9.80
Ash	7.90
Potassium iodide	6.45
Sodium salicylate	6.13
Alkaloids	trace
Phenolphthalein	absent

The preparation, therefore, consists of potassium iodide and sodium salicylate (both well-known specifics for rheumatism) and an alcohol-glycerine infusion of a small amount of an unidentified vegetable drug, to which the trace of alkaloids found may be due.

The familiar legend "This is not a patent medicine, etc.," found on all A. D. S. preparations, has already been discussed under Syrup of Figs, page 156.

Rheumatogen.

27532. *Rheumatogen,* alcohol 20 per cent., Rheumatogen Chemical Co., New Haven. "The latest and most scientifically compounded preparation for the treatment of rheumatism in all its manifestations. It is especially adapted for Rheumatic Joints, Gout, Lumbago, Sciatica, and all ailments arising from kidney and bladder trouble. For Relief of Pain of Nervous Origin no Better Remedy is Known." Capacity of bottle, 4 ozs.; cost, 50 cents.

A brown liquid, specific gravity at 15.5° C., 1.0309; alcohol by weight, 13.3 per cent., by volume, 17.2 per cent.; solids, 12.70 per cent.; glycerine, 0.80 per cent.; ash, containing carbonates, sodium and small amount of sulphates, 3.95 per cent.; sodium salicylate, 10.93 per cent.; phenolphthalein and iodides, none; senna, present.

A positive test for alkaloids was secured with Mayer's reagent; further tests gave results similar to those noted under the preceding sample, and were not sufficiently conclusive for the identification of morphine or its derivatives.

A summary of the analysis follows:

Specific gravity at 15.5° C.	1.0309
Alcohol by volume	17.20
Solids	12.70

Glycerine	0.80
Ash	3.95
Sodium salicylate	10.93
Alkaloids	trace
Senna	present
Iodides and phenolphthalein	absent

The preparation appears to be simply a mixture of sodium salicylate and an alcoholic infusion of vegetable drugs, chiefly senna, to which the trace of alkaloids found may be due. Sodium salicylate is a specific for rheumatism and senna is a well-known laxative. The sodium salicylate present (the drug to which the preparation owes its value in the treatment of rheumatism) is worth about 1.25 cents.

Sanatogen.

26941. *Sanatogen,* the Food Tonic. Bauer & Co., Berlin. "Net weight, 200 gms." Net weight found, 199.5 gms.; cost, $1.90. "A definite, organic combination of 95 per cent. of pure, especially prepared Casein and 5 per cent. of Sodium Glycero-Phosphate." Whether or not this preparation is an organic "combination" we cannot say, but our analysis substantially satisfies the above claim as to the ingredients present. We have made a very careful and detailed analysis of this product in the effort to prove the nature of the protein and phosphorus compound or compounds present. The details of this analysis, and the methods used will be published elsewhere. Below will be found a summary:

Water	9.97
Total nitrogen	12.81
Nitrogen precipitated by acetic acid	12.54
Equivalent to casein	80.01
Ether extract	0.11
Ash	5.59
Sulphur	0.73
Sulphur due to casein	0.64
Phosphorus	1.49
Phosphorus in inorganic form	0.11
Phosphorus due to casein	0.69

The material is a mixture of casein and sodium glycerophosphate, with a small amount of unidentified protein, equivalent to 0.23 per cent. nitrogen, containing both phosphorus and sulphur,

and a small amount of phosphorus, 0.11 per cent., in inorganic combination. The manufacturer's claims as to its composition are therefore substantiated, but many of the statements as to its food value made in its various advertisements will not stand close scrutiny, and savor strongly in certain instances of the typical proprietary medicine advertisement. The following are a few quotations of this nature:

"In Sanatogen, by an intricate process of manufacture, casein and sodium glycerophosphate are united so intimately as to form a new and distinctive compound which is absorbed and assimilated with extraordinary facility."—*Sanatogen circular.*

"Sanatogen the Food Tonic will once more make you a cheerful partner with good health. It will furnish materials for your life-force to grasp, absorb and build on."—*Boston Transcript,* June 4, 1910.

"The Wan and Despondent Neurasthenic, who responds so poorly to the routine treatment of functional nervous disorder, will 'take on the native hue of resolution,' under Sanatogen."—*Amer. Jour. Clin. Med.,* March, 1911.

"It effects nutrition directly by arousing metabolic activity. . . . It causes gain in flesh, strength and vigor of brain and body."—*N. Y. Med. Jour.,* Dec. 30, 1911.

". . . . Sanatogen supplies this deficiency [of nervous energy]—renews the strength—vigor and vitality—restores the depleted nerves and worn tissues to their normal health."—*The Literary Digest,* Nov. 12, 1910

"Sanatogen is science's logical answer to the call of the nerves, the *food* answer to the hungry cry of impoverished conditions, however these conditions may have been brought about, by fret, illness, stress of work domestic, business or social exactions—with distressing results in sleep in appetite, in 'blues,' in outlook on life."—*The World's Work,* Dec., 1911

"Sanatogen is four times as easily digested as wheat flour. Sanatogen possesses splendid tonic and vitalizing properties that place it high above any ordinary food-stuff of whatever kind."—*Chicago Record-Herald* Nov. 28, 1911.

"Patients in a very low condition of health have been sustained for prolonged periods upon Sanatogen alone; this proves it to be a life sustaining agent in itself."—*Sanotogen circular.*

In opposition to these sweeping claims we call attention to excerpts from the Journal of the American Medical Association quoted in the North Dakota Food Department Special Bulletin 2 (6), p. 107:

"Only the highest class magazines and newspapers have been patronized; the 'copy' has been so written as to appeal not to the ignorant but to the intelligent. . . . . Truly, a wonderful preparation if these stat

ments are true; but they are false, most of them at least, and, in that many who can ill afford it may be led to pay a ruinous high price for a very ordinary food, the statements are viciously and cruelly false."

"Dr. Barker, Professor of Medicine, Johns Hopkins University, says: 'If Sanatogen consists simply of casein and sodium glycerol phosphate, it is pretty obvious that all of its good effects (excepting perhaps the psychic influence of taking an expensive and, to the layman, mysterious product) can be gotten by including eggs and milk in the food.'"

"Dr. Folin of the Harvard Medical School says: 'For myself, or for any one who would take my advice, I would prefer a glass of milk to Sanatogen when hungry and plain glycerol phosphate to Sanatogen when in need of a tonic. Medicated food used to be sold for horses. To me the "food tonic" combination represents one of the most unscrupulous fake ideas used by manufacturers of patented articles to fool the public.'"

"Dr. Lusk of Cornell University, after condemning Sanatogen and stating that its nutritive material could be secured in one pint of milk, comments upon the value of the glycerol phosphate as follows: 'That sodium glycerol phosphate has any distinctly beneficial physiological action has never to my knowledge been shown.'"

In spite of these words of condemnation Sanatogen is strongly endorsed by certain European scientists and literary men of more or less reputation. It is difficult, therefore, for the layman to venture an opinion as to its merits as a food and a tonic, other than to point out that its chief constituents, casein and organic phosphorus, may be obtained just as well in milk and eggs at a very much lower cost.

Pinex.

26942. *Pinex,* The Pinex Co., Ft. Wayne, Ind. "Alcohol 17 per cent., 22 minims chloroform per fluidounce, and other valuable ingredients." "Pinex is guaranteed to do all that is promised in the Booklet" (which accompanies each bottle). Capacity of bottle, 2.5 fl. ozs.; cost, 50 cents. A thick, reddish brown liquid, having the odor and taste of tar and chloroform.

The following analytical data were obtained:

Specific gravity at 15.5° C.	1.2220
Alcohol by weight	11.70
Alcohol by volume	18.00
Total solids	60.00
Glycerine	19.50
Solids—glycerine	40.50
Sucrose (by Clerget.)	27.19
Tar, etc. (by difference)	13.31

Ash	2.11
Polarization, direct at 23° C	+28.4
" after inv. at 23° C.	−7.26
Sulphates, chlorides, sodium, potassium, carbonates (in ash)	present
Croton oil, iodides	none
Chloroform, minims per fl. oz.	17.9

While Pinex is recommended for "consumption, asthma, bronchitis, croup, whooping cough, hoarseness, coughs, colds, la grippe, chronic weakness of the lungs and all diseases of the throat and lungs," a consideration of its claims in connection with consumption alone is especially interesting. In the booklet referred to above we find the following under the caption "Pinex Syrup for Consumption" (Italics are ours):

"We have told you that Pinex is a concentrated compound extract of Norway pine. You probably know that white pine is a great sedative for any inflammation or irritation of the lungs, throat or bronchial tubes. You also know that pine forests are very healthy to live in; especially so for consumptives. The natives of the pine forests seldom have coughs or consumption. What is the reason? What is there in the air of these regions to be so effective? It is the Guaiacol and several other volatile constituents of the pine. It is the volatile principles of these agents that make a residence in the pine woods of Norway so invigorating to consumptives. In the past 25 years *Guaiacol has been considered by the most celebrated physicians of the day to be the most useful known remedy for consumption.* The Guaiacol in Pinex makes *Pinex an almost certain remedy for consumption.* . . . Two other very essential things in curing consumption are plenty of *'fresh air' and good, plain, substantial, wholesome food.* Years of experience among physicians has proved that *'fresh air' and good food alone will often cure consumption,* even in deep-seated cases. . . . Plenty of good fresh air and Pinex will do all that could be done were you living in the Pine woods of Norway. . . . For any cough get the best remedy you know. Don't risk some puny remedy, for nothing can be too sure. It means everything to know that *when you give Pinex Cough Syrup you are safe.*"

There are both truth and distortion of the truth in the above claims. There is no doubt that fresh air and abundant nutritious foods are useful in preventing consumption and in the checking of an incipient tendency towards that disease. It is also true that "fresh air and good food alone will often cure consumption." The above statements, however, have no connection whatever with Pinex. The guaiacol in Pinex does not make Pinex "an

almost certain remedy for consumption," for there is no such "almost certain remedy," and while traces of guaiacol may be present in Pinex, *we were unable to detect any by the U. S. P. tests.* The statement that "when you give Pinex Cough Syrup you are safe" would be consoling if true.

Guaiacol, or creosote of which guaiacol is an important constituent, is recognized as of value in the treatment of consumption. No medicine, however, can take the place of fresh air and nutritious diet, and self-medication is always dangerous, especially in the case of a disease like consumption.

Pinex is not supposed to be used in the form in which it is sold. The 2.5 ozs. sold are to be "combined with syrup or strained honey, making a full pint of excellent laxative cough medicine." With reference to this point the booklet says:

> "Our reason for not placing Pinex on the market already prepared is that we are teaching you Health Economy. Most cough medicines contain a large quantity of Sugar Syrup—a very useful element and not expensive. When you buy Pinex you pay for the medicinal ingredients only."

In spite of these statements we find 27.19 per cent. of sugar and 19.50 per cent. of glycerine in Pinex, showing the claim to be both misleading and untrue.

FOOD AND DRUG PRODUCTS EXAMINED FOR THE DAIRY AND FOOD COMMISSIONER.

Seven hundred and fifty-seven samples were referred to this station by the Dairy and Food Commissioner for examination. Since the details regarding them will be found in this report, only a brief summary of the results is here given, except in the case of turpentine, where quite complete analytical data were secured.

Of the whole number of samples examined, 354 were not found to be adulterated, while 372 were adulterated, misbranded, or below standard.

Butter and Butter Substitutes. Of thirty-nine samples examined eighteen were butter, ten oleomargarine and eleven renovated butter. One sample of renovated butter, claimed to weigh one pound, weighed only 14.4 ozs. In many cases the illegality of

the sale consisted in the failure to display the required sign when selling oleomargarine, or failure to stamp renovated butter at the time of sale.

Candy. Six samples of candy examined were in all cases free from paraffin and added mineral matter. Where chocolate was claimed, no foreign fat was present. All contained glucose, and one was colored with amaranth, a permitted coal-tar color. All the samples were passed. The analyses are given below:

	Water.	Ether Extract.	Fat. Ref. Ind. 40°.	Fat. Melting Point.	Polarization at 18°. Direct.	Polarization at 18°. Invert.	Ash.
*Chocolate Nut Caramels..	9.35	6.31	1.4567	31°	+109.4	+41.1	0.49
Chocolate Creams........	10.71	9.38	1.4567	32°	+ 98.6	+17.2	0.58
Chocolate Mints.........	10.38	11.09	1.4577	31°	+ 97.0	+18.3	0.70
Chocolate Creams........	10.65	9.97	1.4569	32°	+ 92.0	+20.5	0.62
†Chocolate Nut Caramels..	9.49	10.32	1.4566	30°	+ 88.0	+24.4	0.94
‡Strawberry Jellies........	16.50	0.15	......	..	+118.0	+34.3	0.23

Cider. The sample examined contained benzoic acid.

Cinnamon. Two samples were tested with the following results:

Ether Extract. Total.	Ether Extract. Volatile.	Ether Extract. Non-Volatile.	Ash. Total.	Ash. Water-Sol.	Ash. Acid Insol.
3.51	1.53	1.98	4.87	1.31	1.58
1.72	0.46	1.26	5.15	1.64	0.47

The microscope showed no added adulterant in either sample, but the volatile and non-volatile ether extract in the second sample were both too low for genuine cinnamon.

Cocoa. The three samples examined were all misbranded and one was adulterated with sugar. Bartlett's Ralston Health Club Cocoa contained 54.38 per cent. sucrose, which was not declared on the label. Bensdorp's Royal Dutch Cocoa showed high ash and high alkalinity of ash. The claims that it was "the purest cocoa made" and that it was "soluble" were both untrue. Isenburg's White Lily Cocoa contained 22.76 per cent. of fat and 3.26 per cent. of nitrogen; it was therefore not "double the strength of ordinary grades of cocoa," as claimed on the label.

Coffee. The sample examined was not found adulterated.

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*The nuts made up 6.7 per cent. of the sample. †The nuts made up 9 per cent. of the sample. ‡Contained amaranth, a permitted coal-tar dye. None of the samples contained paraffin.

Cream. One of the two samples tested contained only 11.25 per cent. of fat, and was therefore below the legal standard. Neither sample contained a chemical preservative.

Grape Juice. A sample of Puritan Grape Juice was found to contain only natural color.

Ice Cream. Twenty-five samples were tested for butter fat, which ranged from 1.0 to 18.5 per cent. Three samples were notably deficient, containing only 1.0, 3.0 and 4.0 per cent., respectively.

Lemon Extract. One of the two samples tested contained 8.9 per cent. lemon oil, with natural color. A sample of French's Triple Strength Lemon Extract contained no lemon oil, and was colored with napthol yellow S, a permitted coal-tar color. The carton claimed "triple strength," the bottle "genuine extract," and a sticker on both the carton and bottle stated in very fine print that it contained "no" lemon oil, a series of inconsistent and misleading statements clearly making the sample misbranded.

Milk. Two hundred and sixty-five samples were examined. Of these forty-five conformed to the legal standards, while sixty-one were deficient only in solids-not-fat. Eighty-five samples were below standard in solids, thirty-four in fat and one hundred and forty-nine in solids-not-fat, two hundred and twenty samples failing to meet the legal requirements in one or more particulars. Four samples were skimmed and fifty-seven were watered. It is to be remembered that these figures do not correctly indicate the true state of Connecticut market milk, as with few exceptions these samples were taken because they *were* suspicious and complaints had been made of the vendors.

The watered samples were taken in Branford, Cheshire, Hebron, Middletown, New Canaan, Rocky Hill, Seymour, Somers, Stafford Springs, Stratford, West Haven, Winchester and Woodbridge. These samples averaged 10.09 per cent. solids, two samples containing only 6.75 and 6.96 per cent.

Skim Milk. Two samples of skimmed milk were found to be watered. These contained 7.56 and 7.84 per cent. solids and 0.13 and 0.21 per cent. fat, respectively.

Molasses. One hundred and sixty samples were examined chiefly for the presence of glucose. In certain samples, showing low polarization, water was also determined. No adulteration

was found in one hundred and forty-eight samples. The direct polarization in these ranged from +17.8 to +50.8, average, +36.7; the polarization after inversion from —8.8 to —17.8, average, —17.5; all at 18° C. One sample contained glucose, polarizing +96.6 direct and +72.2 after inversion. The remaining eleven samples exceeded the standard's limit for water, 25 per cent., ranging from 25.23 to 27.53 per cent.

Olive Oil. One sample was unadulterated, while another contained cottonseed oil.

Rice. Eighteen samples were examined, nine of which were passed, and nine were found to contain talc or similar material. (See page 121).

Sausage. Sixty-eight samples of sausage, frankfurts, etc., were tested for starch, boric acid and sulphites. None of the samples contained boric acid. Twenty-seven samples were passed; these contained from 0.00 to 0.88 per cent. starch, and from none to 2.2 mgms. of sulphurous acid per 100 gms. of material. One sample was rotten when received and totally unfit for human consumption. Thirty-four samples contained starch, ranging from 1.01 to 6.56 per cent., average, 3.02 per cent. Two samples contained excessive sulphurous acid, 6.6 and 9.4 mgms. per 100 gms. Four samples, all frankfurts, contained a coal-tar dye and from 3.22 to 4.73 per cent. of starch. In two cases the dye was identified as ponceau and amaranth, respectively, both permitted colors.

Vanilla Extract. A sample of Alliance Brand was found to be genuine, containing 0.209 per cent. vanillin, and no coumarin or caramel.

Acetic Acid. Three samples were examined, one of which sold by A. L. Embree, Stamford, contained only 28.12 per cent. acid, or 78.1 per cent. U. S. P.

Asafetida, Powdered. Eleven samples were analyzed, ten of which failed to satisfy the U. S. P. standards for alcohol-soluble resins and ash. (See page 152.) Another sample, taken on the request of a large wholesaler and guaranteed to contain 61.3 per cent. soluble resin and 16.675 per cent. ash, contained 61.84 and 17.18 per cent., respectively, showing that a high-grade powdered asafetida is by no means an impossibility, as often claimed.

Citrate of Magnesia. Twelve samples of solution of magnesium citrate were examined. Four of these were within 10 per cent. of the U. S. P. standard, four were deficient in magnesia, one in potash, and three in both of these ingredients. (See page 164.)

Precipitated Sulphur. Three samples were examined, one of which sold by Goldfield Bros., Hartford, was ground brimstone and not the drug claimed. (See page 172.)

Turpentine. One hundred and thirty samples were examined. Full analytical details are given on page 176.

Net Weight Samples. Two hundred and eighty-eight samples were examined in connection with a study of the variations in net weight and volume of package goods. The results of this study are given in detail in Bulletin 172 of this station, and certain data as to individual brands on pages 139 to 145 of this report.

MISCELLANEOUS MATERIALS SENT BY PRIVATE INDIVIDUALS.

Milk. Twelve of the twenty-one samples tested satisfied the legal standard, while seven were below it. One sample tested for preservatives only contained no boric or benzoic acid or formaldehyde. One sample, the duplicate sample taken by a city milk inspector, contained 18.23 per cent. solids and 9.4 per cent. fat; the seal was in poor condition and the sample was apparently tampered with in a very clumsy manner. In addition to these the morning and evening milk of the individual cows of a herd of fourteen were tested for fat. This ranged from 3.8 to 6.1 per cent. for the morning and from 4.4 to 8.1 per cent. for the evening milk, the latter averaging 0.8 per cent. higher.

Cream. Four samples were tested, ranging from 17.5 to 55.5 per cent. of fat. Sucrate of lime was found in none of the samples.

Skim Milk. The single sample tested contained 9.98 per cent. solids and 1.4 per cent. fat.

Condensed Skim Milk. The samples contained 0.85 per cent. fat, and gave a negative test for sucrate of lime.

Butter. Of the three samples tested one was genuine, one was renovated butter, while the third was an inferior product, probably containing some renovated butter.

Near Beer. A sample sent in by the State Police showed a specific gravity at 15.5° C. of 1.00303, and contained 1.36 per cent. alcohol by weight and 1.73 per cent. by volume.

Baking Powder. The sample proved to be a phosphate powder.

Celery. A sample covered in places with a considerable quantity of a greenish deposit was examined. This deposit was found to consist chiefly of copper carbonate, probably the result of spraying, but no arsenic was present. It was reported that much of the celery sold in the Bridgeport markets was found by the local inspectors to contain this contamination.

Cider. The sample examined had the following analysis: Specific gravity at 15.5° C., 0.99786, alcohol by volume, 6.58, solids, 1.56, acidity, 0.36, ash, 0.28, polarization at 20° C. (200 min. tube), —0.5°; salicylic and benzoic acids absent.

Ice Cream. The sample tested contained 10.50 per cent. of fat.

Fruit Syrups. Four samples of strawberry syrup were tested for glucose, one of which contained this sugar. A sample of peach syrup, claimed by a certain New Haven newspaper to have poisoned a woman drinking a soda water flavored with it, was tested for hydrocyanic acid with negative results. It was, however, colored with a coal-tar dye, but reliable evidence showed the woman's sickness to have been due to other causes.

Jam. The sample of strawberry jam examined contained no glucose.

Oysters. A sample of Saltesea Oysters, put up by the American Oyster Co., Providence, R. I., contained no salicylic, benzoic or boric acids. The total net weight of the sample was 502 gms., of which 393 gms. was oysters and 109 gms., or 21.7 per cent., the drained liquor.

Peanut Butter. The single sample tested proved to be genuine, no oil other than peanut being detected.

Lemon Extract. A sample made by Polk & Calder Drug Co., Troy, N. Y., was found to be genuine. Its analysis was, specific gravity at 15.5° C., 0.8162, alcohol about 92 per cent., lemon oil, 5.3 per cent., color, natural, wood alcohol, none.

Sage. The sample made by the R. T. French Co., Rochester, N. Y., was found to be genuine.

Spaghetti. A sample of Marvelli Spaghetti, made by the Marvelli Co., Harbor Beach, Mich., was claimed to be very rich in

gluten and low in starch, and hence permissible for the use of diabetic patients. It contained only 15.50 per cent. of protein.

Vinegar. Twelve samples were tested for solids and acidity. They ranged from 0.56 to 4.92 per cent. acidity, and from 0.77 to 2.75 per cent. solids. Only three of the samples satisfied the legal requirements in both respects.

Malt Carbonic. Two samples of Sunlight Brand Ebling's Malt Carbonic, made by The Ebling Brewing Co., New York, were sent by officials from "no license" towns. One sample contained 3.08 per cent. alcohol by weight and 3.93 per cent. by volume. The complete analysis of the other sample follows:

Specific gravity	1.0167	Ash	0.13
Water	91.09	Phosphoric acid	0.035
Alcohol, by weight	3.34	Dextrin	1.53
" by volume	4.27	Dextrose	0.00
Extract	5.57	Maltose	3.59
Crude protein	0.24	"Bitters" (sol. in alcohol and ppt. by lead)	present

The distribution of the sugars and the amounts of extract, protein and phosphoric acid indicate that the product is a malt liquor. The liquor has the nature, substance and quality of beer, and its sale is illegal where the sale of alcoholic beverages is forbidden.

Poisoning Cases. Several samples of soils, feeds, etc., which were suspected of having caused poisoning in cattle, were analyzed. Two samples of wheat middlings, sent by F. F. Brewster, New Haven, contained arsenic and copper, probably in the form of Paris green. A material sent by J. L. Gardner, Central Village, was tested for arsenic and alkaloids with negative results. Four samples were sent by R. Wohlgeschaffen, Turnerville, two consisting of portions of stomach tissues of cows which had died suddenly, and two consisting of portions of the stomach contents from the same cows. All four samples contained considerable arsenic. Eight samples of soil sent by G. Martin, Milford, were tested for arsenic with negative results. The stomach contents of a cow, sample also sent by Mr. Martin, contained large quantities of lead and arsenic.

TABLE XXXIV.—SUMMARY OF RESULTS OF EXAMINATION OF FOOD AND DRUG PRODUCTS IN 1912.

	Not found *Adulterated.	*Adulterated or below standard.	Compound.	Total number examined.
Sampled by Station.				
Corn, Canned	..	..	..	36
Dried Fruits	..	2	20	102
Gluten and Special Foods	5	6	..	11
Honey	25	‡1	..	26
Rice	21	‡18	5	44
Tomatoes, Canned	§32	9	..	41
Acetic Acid	15	10	..	25
Aconite, Powdered	1	5	1	7
Asafetida, Powdered	2	15	..	17
Fig Syrup Laxative	..	..	..	13
Glycerine	30	..	..	30
Heroin Tablets	3	1	..	4
Magnesium Carbonate	7	¶7	4	18
Magnesium Citrate, Solution	4	27	..	31
Opium, Gum	1	..	..	1
Opium, Powdered	5	..	..	5
Paregoric	32	7	..	39
Sodium Salicylate	8	†5	..	13
Sulphur, Precipitated	12	3	..	15
Proprietary medicines, etc	..	..	..	18
Total	203	116	30	496
Sampled by Dairy Commissioner.				
Butter and Butter Substitutes	18	21	..	39
Candy, Cider, Cinnamon, Cocoa, Coffee, Cream	9	6	..	15
Grape Juice, Lemon Extract, Skim Milk, Olive Oil	3	4	..	7
Milk	45	‖220	..	265
Molasses	148	12	..	160
Rice	9	9	..	18
Sausage	27	41	..	68
Vanilla Extract	1	..	..	1
Acetic Acid	2	1	..	3
Asafetida, Powdered	1	10	..	11
Magnesium Citrate, Solution	4	8	..	12
Sulphur, Precipitated	2	1	..	3
Turpentine	85	39	6	130
Package Goods (net weight study)	..	..	..	288
Total	354	372	6	1045
Sampled by Private Individuals.	61	20	1	104
Total from all sources	618	508	37	1645

* Also includes misbranding. † Short weight. ‡ One short weight. § Probably many of these also contained added water. ¶ All short weight, and one misbranded as well. ‖ Includes 61 samples below standard in solids-not-fat only.

PART III.

TWELFTH REPORT

OF THE

State Entomologist of Connecticut

To the Director and Board of Control of the Connecticut Agricultural Experiment Station:

I transmit herewith my twelfth report as State Entomologist of Connecticut. It contains an account of the activities of my office for the calendar year of 1912, but as in previous reports the statements regarding finances and the inspection of imported nursery stock apply to the State fiscal year ending September 30th.

Respectfully submitted,

W. E. Britton,
State Entomologist.

Report of the Receipts and Expenditures of the State Entomologist from October 1st, 1911, to September 30th, 1912.

Insect Pest Account.

Receipts.

From E. H. Jenkins, Treasurer		$3,000.00
Account of 1911, balance		765.99
Miscellaneous		12.93
		$3,778.92

Expenditures.

For Field, office and laboratory assistance:		
B. H. Walden, salary	$1,080.00	
H. B. Kirk, salary	562.50	
D. J. Caffrey, salary	219.00	
E. B. Whittlesey, salary	301.00	
F. M. Valentine, salary	150.00	
Other assistance	110.13	
		$2,422.63

Printing and illustrations	$281.88	
Postage	56.02	
Stationery	17.35	
Telegraph and telephone	3.90	
Express, freight and cartage	6.65	
Library	184.67	
Laboratory apparatus and supplies	97.51	
Office supplies	57.32	
Traveling expenses	390.88	
Balance, cash on hand	260.11	
		$3,778.92

Gypsy Moth Control Account.

RECEIPTS.

From E. H. Jenkins, Treasurer	$2,500.00
Account of 1911, balance	168.97
	$2,668.97

EXPENDITURES.

For Salary, labor, board of scouts, etc.:			
D. J. Caffrey, salary	$ 766.00		
Labor, board of scouts, etc.	1,268.79		
		$2,034.79	
Printing and illustrations		2.40	
Tools and supplies		54.84	
Telegraph and telephone		.25	
Express, freight and cartage		1.98	
Traveling expenses		343.64	
Balance, cash on hand		231.07	
			$2,668.97

Memorandum:—This account of the State Entomologist has been duly audited by the State Auditors of Public Accounts.

PUBLICATIONS OF THE ENTOMOLOGICAL DEPARTMENT, 1912.

By W. E. BRITTON:

Eleventh Report of the State Entomologist (Part IV of Station Report for 1911): 88 pages, 10 text figures, 16 plates; 9,000 copies distributed in March, 1912.

Report of Committee on Injurious Insects: Proceedings Connecticut Pomological Society, 1912, p. 37, 4 pages.

Progress in Exterminating Two Isolated Gypsy Moth Colonies in Connecticut. *Journal of Economic Entomology*, Vol. V, p. 194, 2 pages, April, 1912.

Spread of the Leopard Moth in Connecticut and Its Injury to Shade Trees. *Journal of Economic Entomology*, Vol. V, p. 241, 2 pages, June, 1912.

The House Fly as a Disease Carrier and How Controlled. Bulletin Connecticut State Board of Health, 10 pages, 1 plate, June, 1912.

The Rôle of the House Fly and Certain Other Insects in the Spread of Human Diseases. *Popular Science Monthly*, Vol. LXXXI, p. 36: 14 pages, 5 figures, July, 1912.

The Mosquito Plague of the Connecticut Coast Region and How to Control It. Bulletin 173 of this Station: 14 pages, 4 plates; 10,000 copies, July, 1912.

Review of Sanderson's "Insect Pests of Farm, Garden and Orchard," *Science*, June 14, 1912.

The Leopard Moth (Summary of Bulletin 169 of this Station) with Illustrations. *Connecticut Farmer*, January 13, 1912.

Inspection of Apiaries in 1911, *Connecticut Farmer*, February 24, 1912.

Inspection of Imported Nursery Stock in Connecticut, *Connecticut Farmer*, June 15, 1912.

Improvement of Salt Marshes, *Connecticut Farmer*, August 3, 1912.

The House Fly and Its Relation to Typhoid Fever, Proceedings of the Sixth Sanitary Conference of the Health Officers of Connecticut (with discussion); 17 pages, October, 1912.

Notes of the Year from Connecticut, *Journal of Economic Entomology*, Vol. V, p. 464, December, 1912, 2 pages.

Inspection of Apiaries in 1912, *Connecticut Farmer*, November 23, 1912.

By G. P. Clinton and W. E. Britton:

Test of Summer Sprays on Apples, Peaches, etc. (Part V, Report of this Station for 1911), 60 pages, 8 plates. 9,500 copies, May, 1912.

By B. H. Walden:

Common Household Insects. *Connecticut Farmer*, March 16, 1912.

White Pine Weevil, *Connecticut Farmer*, July 6, 1912.

Entomological Staff.

W. E. Britton, Ph.D.	*State and Station Entomologist.*
B. H. Walden, B.Agr.	*First Assistant.*
Donald J. Caffrey, B.S.	*Assistant.*
Harry B. Kirk*	*Assistant.*
Miss E. B. Whittlesey†	*Stenographer.*
Miss Frances M. Valentine‡	*Stenographer.*

Mr. Walden has continued as assistant and takes charge of all work in my absence from the office. Mr. Caffrey has been in charge of all field work in suppressing the gypsy and brown-tail moths, and when not needed there has helped in the inspection of nurseries. Mr. H. B. Kirk was engaged to fill the place of Mr.

* Beginning February 15th, 1912.

† Until August 1st, when transferred to botanical department.

‡ Employed temporarily June 17th and regularly since August 1st.

A. B. Champlain, who resigned October 1st, 1911. Mr. Kirk began his work February 15th, 1912, and came to Connecticut from the Division of Economic Zoölogy, Harrisburg, Pa. Mr. Kirk has aided in the inspection of nurseries and of imported nursery stock and has studied the walnut weevil and bud-moth during the summer and also made observations on white pine insects. He specializes in the beetles (order Coleoptera) and has spent considerable time on the collection. He will also assist Mr. Caffrey in scouting for gypsy moth egg masses and brown-tail nests during the winter.

Mr. J. Kirby Lewis, a student of the Massachusetts Agricultural College, was employed during his summer vacation, from June 18th to September 7th, as a general laboratory assistant. So far as is practicable, local help has been employed in the gypsy moth work at Wallingford and at Stonington, and in part on the brown-tail work in the northeastern corner of the State.

Messrs. H. W. Coley of Westport and A. W. Yates of Hartford have continued as apiary inspectors and are paid by the day for the time employed.

Miss E. B. Whittlesey continued to work half of each day as stenographer, until her vacation, July 1st. Miss Frances M. Valentine was employed June 17th to do some special clerical work and to fill the position of stenographer during July. On Miss Whittlesey's return, August 1st, she was transferred to the Director's office for a time and later to the botanical department and Miss Valentine was given a position in this department, working full days, the extra work being necessary.

Much of the success of the work of the department is due to the faithfulness and efficiency of the persons mentioned above, and their services are not unappreciated.

Chief Lines of Work.

Certain routine and police duties are required by law of the State Entomologist, such as suppressing the gypsy and brown-tail moths, the annual inspection of nurseries, the inspection of apiaries on complaint, and the examination of orchards on request. In addition to these prescribed duties for the past four years an attempt has been made to inspect all woody field-grown imported stock to safeguard the State against insect and fungous

pests liable to be introduced in this way. The inspection work in each of its several divisions is described more in detail in the following pages.

Some studies of scientific value have been made during the year. Mr. Kirk devoted a portion of his time in the summer months to investigating the life history, habits, and damage of the walnut weevil, *Conotrachelus juglandis*, Lec. This work, except for further tests of remedial treatment, has been completed, and a comprehensive account of it is given on page 240 of this report. Mr. Kirk also studied another insect, a bud-moth, of the genus *Acrobasis* which causes much injury to walnuts and often works conjointly with the walnut weevil. The results of this work appear in the paper on page 253.

For three years Mr. Walden has made observations on a species of sawfly which he found defoliating cultivated blackberries in a field near New Haven. During the past season he obtained sufficient data to complete his knowledge of the life history of this insect. The species being a new one, was described recently as *Pamphilius dentatus* by Prof. A. D. MacGillivray. The article on page 236 of this report contains all the known facts regarding this insect.

A start has been made in a study of the white pine weevil, *Pissodes strobi* Peck, and other insects attacking pine trees in Connecticut, but several seasons will probably be necessary to obtain the data that would warrant publishing a report.

Some attention has been given to the general care of the orchard trees on the Station farm at Mt. Carmel, where several minor investigations are still in progress.

The control of the mosquito nuisance was actively taken up by several organizations and individuals, during the season, and this office has endeavored to coöperate wherever and whenever possible by furnishing information and advice, and in a number of cases has sent an expert to examine and report upon the suspected territory and to inspect drainage or oiling work. A fuller report of this phase of our work is given on pages 259-288.

There has been a greater demand for popular lectures than ever before, especially regarding the housefly and the mosquito, subjects connected with public health. These demands have been met, if possible, and in most cases the lectures have been illustrated with lantern slides, charts or specimens. Of the thirty

lectures given during the year by Messrs. Britton and Walden, twelve have been illustrated with lantern slides, and twenty-one (eight illustrated) have dealt with flies and mosquitoes.

There has also been a considerable increase in the correspondence and other clerical work of the office.

In connection with the general station exhibit the entomological department made an exhibit of its work at three agricultural fairs as follows:

Norfolk Agricultural Association, Norfolk	Sept. 19–20
State Fair, Berlin	Sept. 24–28
Suffield Fair, Suffield	Oct. 1– 2

This department exhibit was similar to that of last season described in the Report of 1911, p. 264, though somewhat less space was occupied, about 1,200 square feet being used. The mosquito exhibit was made more of a feature than previously and a number of new charts and enlarged photographs added considerably to the appearance of the display.

Summary of Inspection and Office Work, 1912.

315 samples of insects received for identification.
53 nurseries inspected.
52 regular certificates issued.
7 parcel certificates issued.
31 orchards and gardens examined.
987 boxes and packages imported nursery stock examined.
153 apiaries containing 1431 colonies inspected.
73 apiaries containing 337 colonies found infested with European foul brood and treated.
2746 letters written on official work.
179 mail and express packages sent out.
432 bulletins mailed on request or to answer inquiries.
30 lectures and addresses made before granges, clubs and civic organizations.

Entomological Features of 1912.

The winter of 1911-12 was characterized by low temperatures and the ground remained frozen nearly all of the time from December until March. The ground was covered with ice but there was little snow.

Many trees in orchards and in woodlands were apparently injured, either directly by the winter, or, possibly, by the drought

easily damaged by the freezing. At any rate, the buds were killed in nearly all peach orchards, except near the coast, and many oak trees have died during the drought of July and August, 1912, which were probably injured the previous winter. A number of others, half-dead, show signs of winter injury to roots or stems. The cool, moist weather of May favored a luxuriant foliage development on trees, and after the few hot, sunny days of June and July leaf scorch troubles developed on many trees, especially sugar maples.

Seasonal conditions, especially absence or abundance of moisture, winter changes and low temperature have a direct or indirect effect on the scarcity or abundance of the various kinds of insects. The cold, wet spring seemed favorable to the increase of aphids and nearly all kinds were abundant. The rosy apple aphis, *Aphis sorbi* Kalt., was more prevalent and caused more damage than since 1909, many orchards being seriously injured and the fruit stunted by it. The green apple aphis, *A. pomi* DeG., was also common but it causes less injury to bearing trees than *A. sorbi* and its principal damage consists in checking the growth of young trees in orchards and nurseries.

Perhaps the most prominent feature of the season was the great abundance of white grubs (*Lachnosterna* sp.) and the damage caused by them. There were many complaints and several specimens were sent to this office. Evidently the drought favored them as they did more damage than I have seen during a residence of eighteen years in the State. Not only were grass fields attacked and injured, but corn, strawberries and potatoes were also damaged and in some cases nearly destroyed by the grubs. In a forest nursery near New Haven, nearly twenty-five per cent. of the seedling conifers and some deciduous trees were eaten off below the surface of the ground.

The fall army worm, *Laphygma frugiperda* S. & A., was received from Stonington, Groton and from two different localities in New Haven. In three of these places the caterpillars were devastating lawns, and in the other case they were feeding upon a field of millet.

The birch leaf skeletonizer, *Bucculatrix canadensisella* Chamb., though much less abundant than in 1910, was found over the entire State as in 1911, and was particularly noticeable on the yellow birches in Litchfield County in September. It was also

received at this office on cut-leaf and other ornamental birches from various localities.

The leopard moth, *Zeuzera pyrina* Linn., which was fully described in Bulletin 169 and in the report of 1911, continues its destructive work on the shade trees of the shore towns and cities.

The gypsy moth, *Porthetria dispar* Linn., has apparently been exterminated at Stonington, and nearly so at Wallingford. The brown-tail moth, *Euproctis chrysorrhoea* Linn., is spreading a few miles each year towards the south and east. In time it will doubtless spread over the entire State. Though it is held in check by its natural enemies and by the destruction of winter nests and by spraying, it cannot be wholly eradicated as can small colonies of the gypsy moth, because both sexes fly. Detailed accounts of our work against both these insects will be found in this report.

Cut-worms were fairly abundant in June and did their usual amount of injury.

The elm leaf beetle, *Galerucella luteola* Mull., though causing little injury in towns where spraying was thoroughly and universally practiced, ravaged the unsprayed trees in many places, including the roadside and meadow trees of the open country. This insect seems to be now particularly prevalent in the northwestern portion of Connecticut.

The fall canker-worm, *Alsophila pometaria* Harr., as in past seasons, continues to damage apple and elm trees in certain localities.

The spiny elm caterpillar, *Euvanessa antiopa* Linn., was received from a number of correspondents in various portions of the State. Though possibly not as abundant as in 1911, it was nearly as prevalent. Persons often mistake the larvæ for gypsy caterpillars, but the resemblance is slight.

Injury was reported to fruit by the rose chafer, *Macrodactylus subspinosus* Fabr., and the bumble flower beetle, *Euphoria inda* Linn. The white marked tussock moth caterpillars, *Hemerocampa leucostigma* S. & A., were feeding upon a California privet hedge in New Haven in July. The red-humped caterpillar, *Schizura concinna* S. & A., and the yellow necked caterpillar, *Datana ministra* Dru., were in their usual abundance devouring the leaves of young fruit trees late in the season.

The San José scale, *Aspidiotus perniciosus* Comst., was present as usual, and in certain orchards, though thoroughly sprayed, the fruit showed considerable infestation at harvest time. The oyster shell scale, *Lepidosaphes ulmi* Linn., and the scurfy scale, *Chionaspis furfura* Fitch, are present in rather constant numbers year after year but do no very serious damage in Connecticut orchards which otherwise receive good care.

The scale insects which at present attract the most attention are the tulip tree scale, *Toumeyella liriodendri* Gmel., and the woolly maple leaf scale, *Phenacoccus acericola* King. The pine bark aphis, *Chermes pinicorticis* Fitch, is seemingly on the increase and many inquiries regarding it have been received.

The cotton moth, *Alabama argillacea* Hubn., which attracted attention late in September, 1911, by its abundance in its northward flight, also appeared October 11th and 12th, of this year, but in much less numbers than in 1911, and more than two weeks later in the season.

The season of 1912 was a notable one on account of the great abundance of mosquitoes. The frequency of the high tides, together with the long period during which the salt marshes were flooded, gave the salt marsh species a favorable opportunity for multiplying, and they took advantage of it. Thus where no control measures were adopted the salt marsh mosquito, *Culex sollicitans* Walk., was extremely abundant late in the summer, and the rain barrel or house mosquito, *Culex pipiens* Linn., was likewise common and was the source of much annoyance.

INSPECTION OF CONNECTICUT NURSERIES.

The annual inspection of nurseries as required by law was commenced August 26th and finished about the middle of October. The work was done by Messrs. Walden, Caffrey, Kirk and Lewis. Two nurseries were inspected twice, once in the spring and again in the fall. The nursery business is on the increase in Connecticut and a number of the nurserymen have increased their area of growing nursery stock. When this office was established in 1901, the first list of Connecticut nurserymen receiving certificates contained twenty-five names. About half of those nurserymen are still in the business, and the present list has fifty names.

NURSERY FIRMS IN CONNECTICUT RECEIVING CERTIFICATES IN 1912.

Name of Firm.	Location.	Certificate issued.	Number of certificate.	Number of acres in nursery.	Kind of stock grown.
Brothers Nursery Co.	Yalesville	Oct. 8	490	134	Three-fourths fruit; ornamental.
, Wm. H.	New Haven	" 21	505	1*	Ornamental only.
tch, J. H.	Pomfret Center	Aug. 23	470	8	Rare ornamental.
rd Floral and Nursery Co.	Thompsonville	Oct. 1	480	4	Ornamental.
& Co., S. A.	Burnside	Sept. 30	477	1	Fruit and ornamental.
hneider, A.	Danielson	Oct. 5	485	2	Fruit and ornamental.
s Brothers	Westbrook	Nov. 6	511	2	Ornamental.
ghs, Thos. E.	Deep River	Oct. 5	482	1	Ornamental; fruit.
Co., C. R.	Manchester	Sept. 17	473	300	Chiefly fruit; ornamental shrubs.
ian, C. E.	North Stonington	Oct. 5	486	4	Small fruits.
ock & Lyon	Norwalk	" 24	506	30	Chiefly ornamental; fruit stock.
Nursery Co., F. E.	Stratford	" 5	483	34	Chiefly ornamental.
Agricultural College (Prof. A. G. Gulley)	Storrs	" 12	494	5	Chiefly fruit.
Agricultural Experiment Station (W. O. Filley, *State Forester*)	New Haven	Nov. 6	512	2	Forest tree seedlings; chiefly conifers.
y, W. B.	New Haven	Oct 5	488	1	Ornamental.
Highway Nurseries	Westport	" 15	496	10	Chiefly ornamental; some fruit.
& Bertolf	Greenwich	Sept. 26	476	25	Miscellaneous ornamental.
, John E.	Manchester	" 13	472	1	Ornamental.
ock Park Nursery (G. X. Amrhyn, Supt.)	New Haven	Oct. 29	508	8	Ornamental and shade trees.
ity Nursery Co.	New Haven	Sept. 7	471	100	Ornamental and miscellaneous; conifers.
er's Nurseries	Cromwell	Oct. 15	497	10	Two-thirds fruit; ornamental.
rd Park Commissioners (G. A. Parker, Supt.)	Hartford	Dec. 3	517	5	Ornamental only.
& Co., H. S. (2)	Manchester	Sept. 30	479	1	Fruit.
d, H. J.	Sound View	Nov. 11	513	1	Ornamental.

NURSERY FIRMS IN CONNECTICUT RECEIVING CERTIFICATES IN 1912—*Concluded.*

Name of Firm.	Location.	Certificate issued.	Number of certificate.	Number of acres in nursery.	Kind of stock grown.
›n & Sons, J. R.	Mansfield Depot	Oct. 5	484	1	Fruit.
Sons Co., Stephen	New Canaan	Sept. 30	478	300	Fruit, ornamental and shade trees.
rd & Co., Paul M.	Bristol	Oct. 11	493	12	Chiefly fruit; ornamental.
: Co., W. W.	Hartford	Sept. 24	475	10	Mostly ornamental.
r, H. H.	Danbury	Oct. 19	502	3	Fruit, chiefly apple.
& Sons, David	West Hartford	" 16	499	2	Fruit and asparagus.
Carmel Forestry and Nursery Co. (C. A. Metzger, Manager)	Hartford	" 19	504	3	Forest tree seedlings, conifers.
, Chas.	New Haven	" 5	487	1	Ornamental only.
Iaven Nurseries Co.	New Haven	Sept. 23	474	7	Ornamental.
astern Forestry Co.	Cheshire	Oct. 19	503	5	Forest tree seedlings, chiefly conifers.
, J. Wesson	Bolton	Nov. 23	515	1	Asparagus and small fruits.
n, A. N.	Cromwell	Aug. 23	469	1½	Ornamental.
Co., The Frank S.	New Haven	Nov. 22	514	1	Fruit and ornamental.
on, C. O.	Hartford	" 4	510	1	Fruit and ornamental.
Julius	Bridgeport	Oct. 28	507	1	Chiefly ornamental; fruit.
, O. E.	Norwich	" 14	495	8	Wholly ornamental.
hert, F. C.	Bridgeport	Dec. 12	518	2	Ornamental stock only.
J. W.	Hartford	Oct. 18	501	4	Chiefly ornamental; some fruit.
, Wallace	Waterbury	" 31	509	1	Ornamental.
n, C. H.	Hartford	" 17	500	4	Ornamental and fruit.
pe, B. P.	Niantic	Nov. 27	516	2	Fruit.
fus, H. P.	Litchfield	Oct. 4	481	3	Ornamental.
& Co., Chas.	Hartford	" 9	492	5	Ornamental and fruit.
rne & Co., J.	Hartford	" 9	491	10	Ornamental.
uff, C. V.	Orange	" 16	498	3	Miscellaneous.
, Mrs. Nellie A. (2)	Pine Orchard	" 7	489	1	Ornamental.
Total area devoted to nursery stock				1082	

In 1902, just ten years ago, statistics were gathered showing that the thirty-one nurseries contained about 422 acres. Similar data has been collected the present season and there are now fifty nurseries, containing about 1082 acres.

Fifty-three nursery inspections were made during the year and fifty-two certificates issued.

On the whole the nurseries are each year paying more attention to treating their stock to destroy insect pests, consequently their condition as regards San José scale has greatly improved during the past few years. On account of the danger of distributing certain other pests, which are liable to be found on nursery stock, the Connecticut nurseries are now given a closer inspection than ever before.

Some chestnut trees in one nursery had the chestnut bark disease and were destroyed.

In addition to the regular inspection of growing nursery stock, inspections of several packages have been made at the request of persons who are not nurserymen, but wish to ship certain kinds of stock to other states. Seven package certificates have been issued during the year. Of the names published in the nurserymen's list of last year, two have gone out of the business, one has moved his business into an adjoining State, and the others are on the present list. Four new names have been added.

On pages 218 and 219 is a list of the nurserymen and firms receiving certificates in 1912, together with statistics regarding the area and kind of stock in each nursery. In most cases the acreage given is that supplied by the owner, but in some instances it is the estimate of the inspector.

INSPECTION OF IMPORTED NURSERY STOCK IN CONNECTICUT.*

By W. E. Britton and B. H. Walden.

For the past few years there has been a great increase in the amount and value of the nursery stock imported into the United States from European and other countries. In the natural course of events we should expect that many species not commonly cultivated, horticultural varieties and novelties would be brought

into this country for the purpose of increasing the variety of plants available for ornamental planting and of introducing worthy commercial varieties, but we often wonder why such things as California privet, Japanese barberry and the common spiræas, which can be and are so easily grown here, should be imported in such quantities, especially when there is quite a heavy duty to be paid on such stock.

The chief reasons for the heavy importations are the low prices of labor in Europe, and the fact that soil and climate in certain localities there produce fine plants. Were these the only factors to be considered, such importations would be a benefit, not only to the United States, but also to the countries where the stock is grown. But there are insect and fungous pests in all lands, and a number of them have been brought into the United States on nursery stock, so that the traffic is not an unmixed blessing. Our Government has never established any system of inspecting such stock except for customs duties.

No other important nation lacks such a system of inspection. A few years ago, dead San José scales were found on some dried apples and other fruit shipped into Germany; forthwith all American dried fruits were debarred from Germany. Far more dangerous infestations have been found on nursery stock brought here from Germany, France, England, Holland and Japan, yet until October 1st, 1912, the United States has had no inspection system other than that provided in the separate states, and almost no restrictions on the entrance of such stock.

Early in 1909, winter nests of the brown-tail moth were found on stock from France, shipped into a number of states, including Connecticut, and had it not been for the inspection officers in the separate states, who destroyed all nests found, the whole country would now be infested by this most undesirable addition to our insect fauna.

Previous to 1909, no attempt was made to inspect imported stock in Connecticut, but in order to protect the State and its varied horticultural and agricultural interests, such inspection was given, though there was no provision for it except that the law providing for the control of the gypsy and brown-tail moths, enacted in 1907, liberally interpreted, permitted it.

In 1909 and 1910, brown-tail nests were found on fruit seedlings imported from France, but since then none have been found.

though in a number of cases trimmed branches with part of the web remaining showed that the stock had been infested. A number of other kinds of insects, some of which are known to be pests, have been found during the inspections and destroyed. The white pine blister rust has been detected in two or three shipments, and in the spring of this year an importation of 5,000 young pines was destroyed because infested by this disease. Last year a similar disease of junipers from Japan was brought into this State, and as in one of its stages it is injurious to pomaceous fruit in Japan, serious damage might be expected to follow its introduction into Connecticut. We have too many pests already; still, there are several important ones in Europe, and no doubt in other countries, not yet known to be in America. If any one of these becomes established in Connecticut or any other State, the entire country is endangered.

In the season just closed 987 boxes, bales and packages have been inspected by members of the entomological staff. This is more than ever before in a single year, and includes only the hardy plants and woody stock for florists. No attempt has been made to inspect seeds, bulbs, lily-of-the-valley pips, or tender herbaceous plants. Moreover, a number of small shipments of nursery stock could not be inspected because the stock was received and distributed before we were notified of its importation. We have received notice of the arrival of more than 550 boxes, etc., of bulbs and other plant material which we made no attempt to examine, and of about 25 boxes, etc., which could not be traced or found at their point of destination.

The following table shows the amount and source of such stock examined by this office for the past four seasons:

	1909	1910	1911	1912
Belgium	2	91	15	269
England	16	63	91	26
France	71	104	154	97
Germany	93	9	2	9
Holland	109	376	449	534
Ireland	..	18	14	14
Japan	6	26	109	25
Russia	..	1	..	..
Scotland	..	19	2	12
Miscellaneous or unknown	9	..	18	1
Total	306	707	854	987

Congress, at its last session, established the Federal Horticultural Board and provided for a system of applications and permits before any nursery stock can enter the United States, and also gave this Board the right, after due notice and hearings, to establish and enforce quarantine regulations against any country or portion of a country where any serious insect pest or plant disease exists, which is liable to be brought into the United States. This Board also has a similar right to quarantine states or portions of states in this country for the same reasons. This law became operative October 1st, 1912.

The Federal Horticultural Board does not attempt to inspect any stock consigned to the various states having inspection systems, but leaves it to the State inspectors. It does attempt, however, to notify the inspectors regarding the arrival of the stock at the ports of entry. The notice gives the number of the permit issued, name of grower or consignor, name and address of consignee and locality where stock was grown. This enables us, for instance, to trace the stock more easily than we have been able to do in the past, and should result in a careful inspection of a larger proportion of the imported stock needing inspection which is brought into the State. Only field-grown woody plants require inspection under this act. No attempt will be made to inspect herbaceous nursery or florist's stock.

At the present time there is no State provision for this work, but it is important as it safeguards and protects the State from introducing pests in this manner, and there should be some definite provision for its continuance.

INSPECTION OF APIARIES IN 1912.

The inspection of apiaries has been conducted in much the same manner as last year and Messrs. A. W. Yates of Hartford and H. W. Coley of Westport have continued to act as inspectors. An effort was made, however, to inspect apiaries in those portions of the State not previously covered in the work, and considerable European foul brood was found in Litchfield, Torrington, Winchester and Barkhamsted in Litchfield County and some was found in Norwich and Stonington in New London County. Very few apiaries have previously been inspected in these two counties, as no complaints have been filed requiring attention.

In nearly all sections of the State, where apiaries are examined, foul brood is found, and in some cases it does much damage, killing off colonies of bees before its presence is known. Wherever the proper treatment is given, there seems to be no trouble in controlling the disease and in most cases it disappears altogether.

As three hundred dollars is the limit of the appropriation to be expended in any one year, the entire State cannot be covered in a single season. The beekeepers seem to be pleased with the inspection service and treatment, so far as it goes, but at their last meeting they voted to ask for an increased appropriation; and for certain changes in the laws giving authority to inspect without complaints; to place a quarantine upon diseased apiaries; and requiring that a certificate of good health accompany each shipment of bees, whether brought into the State from without or moved from one point to another within the State.

The statistics given below show a summary of the inspection work for the season:

APIARIES INSPECTED, 1912.

		Apiaries.	Colonies.
Number inspected		153	1431
Infested, European foul brood		73	337
Other troubles:			
Pickled Brood	several		
Doubtful	3 cases		
Diseased Adult Bees	6 cases		
Average number of colonies per apiary		9.3	
Total cost of inspection		$299.80	
Average cost of inspection per apiary		1.96	
Average cost of inspection per colony		.21	

GYPSY MOTH CONTROL WORK IN *1912*.

By W. E. BRITTON AND D. J. CAFFREY.

Stonington Infestation.

No caterpillars have been found in Stonington since the summer of 1910 and it is probable that the gypsy moth has been eradicated from that locality. Nevertheless, the place will be watched. Mr. Caffrey, in company with two Federal scouts, examined Stonington, beginning January 4th, 1912, and finishing

January 20th. No egg-masses were found. Nevertheless, the trees were banded the following summer, the bands examined for caterpillars and much scouting done in and around the area formerly infested. No gypsy caterpillars were found. Mr. Fred Hoadley was employed on this work and had immediate charge under our direction of applying, examining and removing the bands. Mr. Hoadley commenced work on May 13th, and finished August 17th. Mr. Caffrey spent three days in July scouting in Stonington.

Number of burlap bands	2210
Number of tanglefoot bands	66

Wallingford Infestation.

An account of the scouting operations at Wallingford, during the autumn and winter of 1911, appears in the last report of this Station (see Report for 1911, page 279). At that time five egg-masses were found through the combined efforts of the State and Federal scouts.

The summer work began on May 13th, and on May 14th tanglefoot bands were applied to 128 trees, including all the spruce and cedar trees in the cemetery and several large hickory, walnut and spruce trees about town. This tanglefoot was stirred from time to time to keep it in a viscid condition.

Commencing on May 15th the burlap bands were placed on all the trees, to the number of 5,379, in the area between North Main, Christian, Cherry, Ward and Fair streets. The area thus treated was somewhat smaller than that of the previous two years, due to the diminished size of the territory where egg-masses and caterpillars were found the year before. Two men were employed to examine these bands at regular intervals from May 23d until August 15th. During this period many suspected trees, especially rough-barked maples and elms, were climbed in search of caterpillars, and in addition all shrubbery and vines, impossible to band with burlap, were examined, as well as some of the territory outside the banded area.

The first caterpillar, one-half inch in length, was found June 1st, under the burlap around a large maple tree in front of "The Woodbine" on Center street. On June 10th, fifteen caterpillars

The road running from Chapinville station north through Chapinville, as far as Hammertown, was followed and included all the territory around Scoville's estate at Chapinville. At Lime Rock the street trees and along the roads to Falls Village were looked over.

North Canaan.

In the town of North Canaan, the junction point of the C. N. E. and N. Y., N. H. & H. railroads, at Canaan village, was looked upon as a dangerous point, as it is only about a mile distant from the Massachusetts state line, and connected by electric railway and within ten miles of Great Barrington, where the gypsy moth has already been found. Careful search of the entire village and roads leading north to the state boundary failed to reveal any signs of infestation.

The main automobile road out through East Canaan was also followed to the town line, as this is the route generally taken, in traveling between the summer colonies of Lenox and Norfolk. The camp meeting grounds at Pine Grove, three miles south of Canaan, where there are many cottages in the midst of a large pine grove, was visited and gone over carefully.

Norfolk.

The entire village of Norfolk was examined and for some distance into the surrounding country. The trees around the garages and driveways of the many summer homes in this section were given special attention, as it was feared that caterpillars from some of the infested towns nearby in Massachusetts might be brought in on the numerous automobiles and other vehicles that pass back and forth between these sections during the summer months. It is at this time that the caterpillars are most active, crawling about in going from tree to tree and frequently hanging suspended over the highways. In this manner they may gain access to any passing vehicle and be carried for a long distance, either dropping off along the way or crawling out of the vehicle when it stops. The vicinity of the Music Shed, where the concerts of the Choral Union are given, was examined, as these concerts come during the months of June, and are attended by many people who come from all directions.

The automobile road leading out through West Norfolk, on the way to Canaan, was followed as far as the town line. On the south everything was looked over as far as the second railroad bridge, and on the east, as far as the group of houses around the fork of the roads, and on the north as far as the cemetery beyond Haystack Mountain.

Sharon.

The central part of the village at Sharon and also the road out through Sharon Valley to the state line, towards Millerton, N. Y., was examined.

Canaan.

In the town of Canaan the only place receiving attention was at Falls Village, where the entire village was examined, including the road leading from the village of Lime Rock and northward on the main automobile road to the village of Canaan.

The result of the work done in these towns would seem to indicate that the gypsy moth has not, as yet, spread into Connecticut at this point from the nearby infested towns in Massachusetts. The danger from this source, however, may be considered to be serious and it will be necessary to keep a close watch on this section, under the conditions now existing.

CONTROLLING THE BROWN-TAIL MOTH IN 1912.

By W. E. Britton and D. J. Caffrey.

Control measures against the brown-tail moth, *Euproctis chrysorrhœa* Linn., in the northeast corner of the State, were continued on the same plan as in the previous year (see Report for 1911, pp. 281-286). Beginning January 29th, 1912, the towns of Thompson, Woodstock, Putnam, Pomfret, Killingly, Brooklyn and adjoining portions of Union, Ashford, Plainfield, Sterling, Canterbury and parts of Lisbon and Griswold, especially around Jewett City, were scouted for the winter nests, together with the city of Willimantic, part of Norwich and the villages in the town of Stafford.

The amount of territory to be scouted made it necessary to employ two gangs for the work. Mr. J. H. Osgood of Putnam, who had been employed by the city in this work, was placed in

charge of one gang, while the other was under the direction of Mr. Caffrey.

The control work of last year has greatly diminished the number of nests, and seems to indicate that the brown-tail moth may be kept from doing serious damage in Connecticut by continuing the present method of control. The limit of territory infested was extended further southward to include the entire town of Killingly, Plainfield as far as Wauregan, Sterling as far as North Sterling, and the eastern edge of Brooklyn as far as Long Brook. Westward along the Massachusetts state line and in the towns of Woodstock and Pomfret the limit of infested territory was reduced about two miles, no nests being found beyond West Woodstock, where a single specimen was taken. Later a single nest was found in Stafford, but in this case it probably came directly from infested territory in Massachusetts.

The greater part of the nests were found along the steam or trolley roads, main highways of travel, or near the towns and villages where the lights were thickest. From many indications it seems probable that the adults are coming in from the adjoining states of Massachusetts or Rhode Island each year, either through their own efforts or are being transported by various means of travel from those two states into Connecticut.

The methods used in scouting were the same as last year. It was found impossible to cover the woodland and brush areas, but the orchards, roadsides, around dwellings, along highways of travel and the open country were very carefully examined for nests. Fruit trees situated close to a house, either in the town or country, prove to be the most likely place to find nests, while the large apple orchards and white oak trees along the roadsides also seem to be preferred by the pests, so these localities were given special attention.

The following is an account of conditions existing in the various towns:

Thompson.

In the town of Thompson the nests were found to be present in about the same localities as last year, but in some instances were greater in number. At North Grosvenordale several small pear and apple orchards near the railroad station yielded 362

of the hill, 203 nests were cut from a clump of white oak trees near the roadside. One tree at this place was so badly decayed that it was necessary to cut it down, before the nests could be removed from its upper branches. In Thompson village the nests were scattered in territory around the four corners at Thompson Inn and on both sides of the road to the railroad station, to the number of thirty-one. On the estate of Norman B. Ream, nearby, where the infestation was first discovered, only four nests were found. On the farm of Howard Ingraham, half a mile north of the village, 156 nests were taken, mostly from one pear tree. At East Thompson, near the Rhode Island state line, sixty-one nests were found. At West Thompson ten nests; Mechanicsville, three; Thompson Station, two; Wilsonville, eight; Quinebaug, seven; and Quaddick, five. Scattering nests were taken throughout the entire township, except in the region around the northern end of Quaddick Reservoir,—bringing the total number for the entire town to 966 nests.

Woodstock.

The conditions in the eastern part of the town were about the same as last year, but in the western part the nests were not nearly as numerous or scattered over as large an area. One nest was found near Davis' general store, at West Woodstock, but the remaining territory westward through Woodstock Valley and Kenyonville and northward to the Massachusetts state line was free from infestation. The orchards and scattered fruit trees in the eastern part of the town required much time for inspection and many nests were found in these places. At W. H. Young's, near South Woodstock, seventy-five nests were taken; at Bastow's, near Harrisville, sixty-five nests; while all fruit trees in this section contained one or more nests, to the total of 498, around South Woodstock. Along Main street, at Woodstock Hill across from the Academy, thirty nests were found; and back of the district school, eleven more. There were very few nests between Woodstock Hill and North Woodstock, four being taken at Echo Farm of L. H. Healey and six others scattered along in as many orchards; around the village of North Woodstock, ten nests; East Woodstock, eighty-three nests, mostly near the road, leading north over the hill. At

Sprucedale, near South Woodstock, twenty-seven nests were taken from trees around the factory there. Two nests were found in the section known as "English Neighborhood," two miles west of North Woodstock, and one other nest near Muddy Pond. In the entire town, 699 nests were found. While in Woodstock, the villages of Union, North Ashford, Eastford, Ashford and Phoenixville were scouted, together with the main roads which connected them, but no infestation was found at any of these places.

PUTNAM.

A great decrease was noted in the number of nests on each tree in the city of Putnam. Some of the trees which were covered with nests last year had only a few this year and the conditions throughout the city in general were much improved. In the territory between the city and the Rhode Island state line, however, especially along the main automobile road to Providence, the number of nests found was greater than last year. Along Elm street, and School street, in the city, were the worst infested places, one apple tree near the railroad station having seventy-three nests, while about seventy nests were cut from the large oak trees on Oak Hill, and forty-one nests from a pear tree at the corner of Elm and Bridge streets. Up through Rhodesville in the western part of the city the nests were not very numerous, or in the region beyond Oak Hill and Main street. At the Town Farm three nests were found; near the Children's Home, at East Putnam, thirty nests; near Day Memorial Hospital, one nest; Putnam Heights and vicinity, 105 nests and a few scattering ones near the Rhode Island state line, making a total of 1,260 nests for the entire town, where 5,989 were destroyed last year.

POMFRET.

Only a small part of Pomfret was found to be infested. The territory south of the New England Division of the railroad was free from nests as was that portion west of Pomfret Center. The worst infested spot was near Prospect Hill, on the stage road from Putnam, where sixty-three nests were cut from a small apple orchard beside the road. Six more scattering nests were found along this road nearer the Putnam town line. In the back yards along Pomfret street we took five scattering nests

one nest on an apple tree near Pomfret Academy and several more around the Clark estate. The nursery of J. H. Bowditch and Lapsley's large orchards, near the southern border of the town, were given special attention but no infestation was found in these places. A total of eighty-two nests were found in the entire town.

Killingly.

In the town of Killingly several scattered infestations were found and these seemed to be the result of adults coming in from Putnam or from an infested portion of Rhode Island. One nest was found at Williamsville near the old grist mill, one at Dayville on Lake Side Farm, one on the loop road to Quinebaug River, one in the borough of Danielson at the corner of North and Main streets; three nests on the farm of Mrs. R. A. Bartlett, three miles north of Chestnut Hill; twelve nests on the Green Hollow road, two miles south of Danielson, on three connecting farms, and two nests one mile further south on the same road, near the Plainfield town line. Six nests were found in the vicinity of South Killingly in the southeast corner of the town. A total number of twenty-seven nests in the entire town.

Brooklyn.

The infestation in Brooklyn was confined to the extreme eastern edge of the town. Twenty-eight nests were cut from a pear tree near Long Brook, two miles out from Danielson, on the main road to Brooklyn village. This pear tree was located within twenty feet of the house and the family residing therein had recently moved from the infested locality in Putnam. Along Allen Hill road, six scattered nests were found in the apple orchards connected with the farms. One other nest was found on the Brooklyn side of Wauregan village, in the southeast corner of the town, near the Catholic Church. There were no nests found in the village or in the western and northern parts of the town. A total of thirty-five nests in the entire town.

Sterling.

The town of Sterling was scouted from Killingly line as far south as the villages of Sterling and Oneco. The fact that the Providence Division of the railroad enters Connecticut through

this section made it particularly liable to infestation. One nest was found in the village of North Sterling, about two miles west of the Rhode Island line. A total of one nest in the town of Sterling.

PLAINFIELD.

The town of Plainfield was scouted, except a section in the southeast corner of the town. The infestation was confined to the vicinity of Wauregan village, where six nests were found on the farm of Mrs. George Davis, on the hill east of the village; four nests on apple trees just below this point; two nests near the Wauregan railroad station on the road leading north, and one nest on the hill between the railroad station and the village. The villages of Moosup, Almyville, Plainfield, Plainfield Junction and Central Village were carefully scouted but no more nests were found. A total of thirteen nests for the town of Plainfield.

While in this section, the villages of Jewett City in the towns of Lisbon and Griswold, Canterbury in the town of Canterbury and the center of the city of Norwich were scouted but nothing was found.

WILLIMANTIC.

The city of Willimantic was scouted for brown-tail and gypsy moths as far as the city limits, but nothing in the nature of an infestation was found.

STAFFORD.

The villages in the town of Stafford were scouted for brown-tail and gypsy moths and to determine the western limit of the brown-tail infestation. One brown-tail nest was found near the Central Vermont railroad station and from the nature of its location the insect was probably brought down from infested territory in Massachusetts, through which the Central Vermont trains pass. The villages of Staffordville, Hydeville, Stafford Hollow, West Stafford and Orcuttville were carefully scouted but no other infestations were found. Total for town of Stafford, one nest.

SUMMARY.

The result of control work against the brown-tail moth during the past season indicates that the number of nests has been

materially decreased throughout that portion of Connecticut known to be infested. The area actually infested has been slightly increased, due to finding a few nests in the adjoining towns of Brooklyn, Plainfield and Sterling, with one isolated specimen taken at Stafford. These towns, with the previous infested area, including Thompson, Woodstock, Putnam, Pomfret and Killingly, make a total of nine towns in the State where the brown-tail moth is known to be present.

The number of nests found and destroyed in each town are as follows: Thompson, 966; Woodstock, 699; Putnam, 1,260; Pomfret, 82; Killingly, 27; Brooklyn, 35; Sterling, 1; Plainfield, 13, and Stafford, 1; making a total of 3,084. Last year (1911) 7,133 nests were found in the territory infested at that time.

The Norwich Infestation.

After finishing the scouting work described above, specimens of the brown-tail moth were received on May 14th, 1912, from Mr. John E. Fanning, 31 Willow street, Norwich, Conn. On May 17th, Mr. Caffrey investigated the matter, and upon his arrival at Norwich, Mr. Fanning pointed out the places where he had observed the work of the insect.

After scouting the surroundings this infestation was found to be an isolated one, confined to a comparatively small space, about 100 yards in length, between Franklin and Chestnut streets, and a small connecting spot in two yards on Broadway, the next street to the westward.

The worst infested spot was at 170 Franklin street. Here three pear trees and one apple tree were partly defoliated. The owner of the property had been badly afflicted with the "brown-tail rash," caused by the poisonous and irritating hairs of the caterpillars, and had been forced to seek the services of a physician. The trees in the adjoining yard of D. S. Underwood were also defoliated, somewhat, the caterpillars at this time being very active and measuring about three-fourths of an inch in length. Further along, at 230 Franklin street, were a few nests on a group of eight pear trees, and caterpillars were feeding upon the foliage. At 258 Franklin street, one nest was found on a pear tree, and the caterpillars were feeding upon the trees nearby. At 89 Chestnut street, some feeding was noticed upon a pear tree.

Back of the Norwich Nickel and Brass Company's Factory, on Chestnut street, were two pear trees containing feeding caterpillars and three or four nests. At the corner of Broadway and Willow streets, on the property of Dr. W. J. Hanford, four nests were found on one pear tree, and on adjoining property, at 125 Broadway, the caterpillars from two nests were feeding on a pear tree.

Arrangements were at once made with Frank Kimball, who contracts for spraying operations in the locality, and the foliage of all the trees found to be infested with nests or caterpillars were sprayed with paste lead arsenate, five pounds to fifty gallons of water. Twenty-two trees were treated in this manner, care being taken to give them a thorough drenching with the poison. In addition to the points named above, and to the work done the previous winter, the trees along the following streets were examined for traces of the insect: Laurel Hill to top of the hill, Spruce, Talmond, Washington to the Parade Ground, Sachem, McKinley through Rockwell, Broad, Warren, Treadwell, Boswell, Cliff, Hobart, Hamlin, Central and North Main as far as Sixth, West Main to corner of Pine and Maple, Maple, Forrest, Cortot, Asylum, Pearl, Mt. Pleasant, Peck, West to first cross road, Uncas, Williams and Lafayette. An effort was made to examine a few trees in all parts of the city, as it was impossible at the time to cover the entire city systematically. The trees were in full leaf, which makes the insect difficult to detect, but no nests or signs of feeding were observed at any of the places, except where the spraying was done.

It seems probable that the brown-tail moth was in some way transported to Norwich from the towns known to be infested in the northeastern corner of the State, or possibly from the infested portion of Rhode Island.

A NEW SAWFLY PEST OF THE BLACKBERRY.

Pamphilius dentatus MacG.

By B. H. Walden.

Adult sawflies collected by the writer in a blackberry field in Hamden, near New Haven, May 24th, 1910, were sent to Professor Alexander D. MacGillivray, who pronounced them a new

species, which he has recently described in the *Canadian Entomologist,* Vol. XLIV, p. 297, as *Pamphilius dentatus.*

When the field was again visited the following season, on June 27th, many sawfly larvæ were found, and the plants showed considerable evidence of their work. A number of these larvæ were taken to the laboratory but no adults were reared. An examination of other blackberry fields in the vicinity revealed no trace of the insect. In the spring of 1912, the place was again visited. The blackberry field where this insect was discovered two years previous had been plowed, but in two other fields nearby the insect was found and was especially abundant on one short row of blackberries near the field originally infested.

Life History and Habits.

The adults appear during the latter half of May, though in 1912, which was a late season, they were first observed on June 1st, were the most numerous June 9th, and the last adults were seen on June 14th.

The eggs are deposited in rows on the under side of the leaf, normally on the lateral veins, with the axis of the egg parallel with them, as is shown on plate II. Occasionally the eggs are fastened to the veins transversely, and very rarely are deposited on the leaf surface between the veins. No eggs could be found on June 1st, but many had been deposited by June 9th. A few larvæ were found on this latter date and all eggs had apparently hatched on June 25th. From fourteen to seventeen days are required for the larvæ to reach maturity, and by July 12th all but one or two had gone into the ground, where they remain until the following spring before pupating. Soon after hatching the young larva spins a few threads, by which it gradually draws a portion of the leaf over itself, forming more or less of a tube, within which it feeds. The larva travels ventral side up on the thin web thus formed, with its back to the leaf upon which it feeds. Where several eggs are on one leaf, the larvæ hatching from them collect together in one web, as the leaf is devoured. Other leaves may be drawn in with the first web and eaten, so all that remains of the leaves are the principal veins, each covered with a thin web, in which are bits of the leaves and castings from the larvæ. See plate I.

The habits of this insect are quite similar to those of the peach sawfly, *Pamphilius persicum* MacG., an account of which was given in the report of this Station for 1907, page 285.

DESCRIPTION.

Egg. White, smooth and shiny; cylindrical, about twice as long as wide, ends round, sides usually straight, though occasionally slightly curved, or somewhat narrow towards the end. Average length, 1.59 mm.; average thickness, .67 mm.

Larva: *newly hatched.* General color, pearly white; head, black; the two basal joints of the antennæ, white; apical joint, black, and the remaining joints dark brown, with the front margins white. Length, 2.5 mm.; average thickness, .48 mm.; antennæ, .27 mm.; cerci, .29 mm. One larva, under observation, increased to 3.5 mm. in length before moulting, and the anal two-thirds of the body became pale green from the food consumed.

1st moult. General color, apical third, dirty yellow, remainder, pale green; head, amber-colored; eye-spots, light brown; a brown triangular spot at center of head; first segment back of head with a faint amber-colored, elongated transverse mark covering about two-thirds of the dorsal surface of the segment; anal plate with a broad, raised portion, starting near the tip, which diverges and becomes two-branched towards the base of the plate; the raised portion and edges of the plate nearly white; remainder, green; cerci with apical joint brownish. Length, 4.5 mm.

2d moult. Head, amber-colored; mouth parts, light brown; eye-spots, triangular mark on front of head and the elongated mark on first segment darker and more prominent than in preceding moulting stage; a dark median line from back of head to anal plate; markings on anal plate more strongly defined than above; cerci with apical, joint black; middle joint with base, dark; apical margin, white; basal joint, white. Length, 11 mm.; average thickness, 2 mm.

3d moult. Head, olive green. In this and the remaining moults the appearance is similar to that of the full grown larva.

Full grown larva. General color, bluish green; body, cylindrical, somewhat flattened and slightly tapering towards either end; legs, small and slender; head, from the front, nearly round,

olive green, mottled and shiny; a dark brown spot near the center of the front at the point where the frontal sutures meet; eye-spots and mouth parts, brown; antennæ, seven-jointed; basal joint, white; apical joint, black; remaining joints, brown with the front margins white; the first segment back of the head with the raised portion brown, below which is a smaller brown spot; anal plate, broadly rounded with the lateral margins raised and with a broad, raised central portion starting at the tip and diverging near its middle into two branches which extend to the base of the plate; cerci, three-jointed; basal joint, broad and about equal in length to the two remaining joints; the first and second joints, white; the last joint, slender, tapering to a point and black in color. Length of larva, 17.5-19 mm.; average thickness, 3 mm.; width of head, 1.75 mm.; base of anal plate, 2.25 mm.

The dorsal and lateral views of the larva, as well as dorsal and ventral aspect of the anal plate and the front of the head, are shown on plate III.

The pupa was not obtained.

Adult. The adult is a moderately large and striking sawfly, somewhat resembling *P. persicum*, but differing from that species in the color of the antennæ, the basal portion of which are black with the remainder white. The tibiæ of the hind legs are black. In *P. persicum* the antennæ are black to the tips and the tibiæ of the hind legs are rufous. See plate III, b.

The facial markings of the female are similar in both species, but differ considerably in the males. The males of *P. dentatus* have the entire face (declivous area) yellow, while that of *P. persicum* has the lower half and margins of eyes yellow with the remainder black.

This species was described by Professor A. D. MacGillivray in the October issue of the *Canadian Entomologist*, Vol. XLIV, page 297, 1912, as follows:

"*Pamphilius dentatus* n. sp.—Body black, with the terminal half of the antennæ, the clypeus, a dentate spot on the inner orbits extended as a parenthesis-shaped mark to the caudal aspect of the head; an emarginate spot in front of the median ocellus and an angular line behind it, a parenthesis-shaped mark at the lateral margin of the vertical furrow, the margin of the pronotum, the tegulae, the V-spot, the scutellum, the postscutellum, a spot on the humeral angle beneath the wings, the front and middle legs and the hind legs except the tibiæ white; the abdomen

rufous beyond the basal plates; antennæ with about twenty-seven segments; supraclypeal area carinated; head depressed about the median ocellus, sparsely punctured; declivous area smooth; median lobe of mesothorax smooth, lateral lobes densely punctured and scutellum sparsely punctured; wings hyaline; veins brownish. Length 8-10 mm.

The male differs in having the entire declivous area yellow and the notum, except the scutellum and the postscutellum, black.

Habitat.—Wilbraham, Mass.; J. O. Martin, collector. Hamden, New Haven and Wallingford, Conn.; B. H. Walden, collector.

This species is near *rubi* Rohwer."

Whether or not this insect will prove a serious pest of blackberries is impossible to state at this time. Most of the feeding takes place on the lower leaves, and very few of the canes in the infested fields were completely defoliated. On the other hand the insect has spread over a considerable area in the past two seasons.

No remedies were tried against the blackberry sawfly, but should it become abundant, spraying the foliage, about the time the eggs are deposited, with lead arsenate at the rate of two pounds in fifty gallons of water, will probably control it.

The blackberry sawfly was not observed feeding on any other species of plant, though both black and red raspberries were grown adjoining one of the blackberry fields where the sawfly was found.

THE LIFE HISTORY AND HABITS OF THE WALNUT WEEVIL OR CURCULIO.

Conotrachelus juglandis, Lec.

By W. E. Britton and H. B. Kirk.

The studies herein described were undertaken for the purpose of learning the life history, habits and seasonal development of this weevil, about which little has heretofore been known, although it was described thirty-five years ago.

The senior author first became interested in this insect through Dr. Robert T. Morris, a well-known surgeon of New York City, who has a farm at Stamford, Conn., and who is an enthusiastic nut grower, and president of The Northern Nut Growers' Association. Dr. Morris has been experimenting for a number of years trying to establish the hardier varieties of commercial nut-

bearing trees, with the idea of introducing the new and interesting industry of nut-growing into the New England States.

Since the spring of 1909 this department has received a number of letters from Dr. Morris, regarding an insect which punctures the nuts of several species of walnuts, and another (a bud-worm) working in the new growth of the same trees. Later, we received letters stating that he had observed weevils puncturing the nuts and had found the larvæ of some insect working in the stems. In July, 1909, Dr. Morris sent specimens of this weevil, which was identified as *Conotrachelus juglandis* Lec.

It was Dr. Morris who suggested that the Station detail some-one to study the walnut weevil. Realizing the importance of the subject, Mr. Kirk was engaged as an assistant with the understanding that such investigations were to be part of his work.

The field studies were made on the premises of Dr. Morris at Stamford, and of Mr. H. L. Champlain at Lyme, supplemented by observations upon such other walnut trees as could be found growing elsewhere about the State.

The general plan of these studies and the present paper are the joint work of the authors. Mr. Kirk has done most of the field work.

The authors hereby acknowledge their indebtedness to Dr. Robert T. Morris and to Mr. H. L. Champlain, who kindly placed their trees at our disposal for study and experiment; to the Bureau of Entomology for identifying specimens and furnishing records; and to many museums and entomologists throughout the country for kindly sending us records from their specimens.

Previous Knowledge of the Walnut Weevil.

In searching the literature and in corresponding with the Bureau of Entomology and with various entomologists, it was evident that little was known about the life, history and habits of this species. B. D. Walsh, the first State Entomologist of Illinois, evidently observed the walnut weevil as early as 1867, but regarded it as a "Phytophagic species" of the common plum curculio. In his first report he states*:—

"But there, actually, in my opinion, does exist a 'Phytophagic species' of the common curculio, which is uniformly one-half larger and which

* Walsh, Report on the Noxious Insects of Illinois, I, p. 86, 1868.

in the larva state feeds, not upon stone-fruit or pip-fruit, but upon green butternuts and walnuts (*Juglans*), from the former of which I bred two individuals, August 13th. Of this peculiar type of curculio I sent specimens six years ago to our great North American authority in the Order of Beetles, Dr. J. L. LeConte; and he pronounced them to be mere varieties of the plum curculio. They scarcely differ from that insect in any other perfectly constant character than size."

In a foot note on the same page he explains:—

"There is, I believe, a slight, but perfectly constant colorational character by which these two forms are distinguishable. The broad band behind the polished black humps on the wing-cases is, in the large-sized nut-inhabiting form, of a dingy white color with a few milk-white spots. In the small plum-inhabiting form, this same band is of a bright ochre-yellow color, with more or less milk-white spots, which last, however, never occupy more than one-half of the ochre-yellow band. Moreover, I am informed by Dr. Hull, that the larva of the large-sized form—with which he has long been familiar—occurs with him in hickory-nuts having their shucks marked by the characteristic crescent-slit, and that this larva 'penetrates to the kernel of the nut.' Whereas, as is well known, the larva of the small-sized form that frequents the plum, never under any circumstances penetrates to the kernel of that fruit. This difference in the habits of the two forms is certainly very remarkable."

Mr. Walsh quotes Dr. Fitch to the effect that specimens found on butternut trees are always larger than those from fruit trees, the difference in size being ascribed, by Dr. Fitch, to the greater food supply.

In 1876 the walnut weevil was described as *Conotrachelus juglandis** by Dr. J. L. LeConte. Since that date the insect has been mentioned several times in the literature, but only as breeding in the nuts. Thus, Brooks, writing in 1910,† describes and illustrates the injury to the nuts by the adults and larvæ of this insect. Dr. F. H. Chittenden, of the Bureau of Entomology, in a letter to the senior author, as late as June 10th, 1911, states:

"This species has never been given careful study to my knowledge, and I have never had an opportunity of testing any remedy against it. I am familiar with its habits, however, having studied it when at Ithaca,

* LeConte, Proc. Am. Phil. Society, Vol. XV, p. 226, 1876.

† Brooks, West Virginia Agricultural Experiment Station, Bull. 128, p. 106, 1910.

N. Y., and found that the larva develops chiefly from the nuts of the walnut."

The first intimation that the insect breeds also in walnut stems came to us from Dr. Morris, who, in July, 1909, sent to this office specimens which he had observed "apparently at work upon a young shoot of *Juglans regia.*" In July, 1911, he sent more specimens and wrote as follows:

"You speak of the injury to the fruit. That is not where the great damage is done. Eggs are laid in the leaf axils, beginning just as soon as the leaves appear. Later eggs are laid also in the stems of the leaves, and later yet in the fruit. Some of my young trees are all but ruined already. It is a terrible pest. The Japanese walnuts, *Juglans sieboldiana* and *J. cordiformis,* are their favorites, then comes the English walnuts, *J. regia.* The chief local tree for attack is the butternut, *J. cinerea.*"

In August of the same year Mr. A. B. Champlain, then an assistant in this department, discovered larvæ working in the new growth of *J. sieboldiana* at Lyme, Conn., and brought samples to the Station insectary, where he bred the adults of *Conotrachelus juglandis,* this being the first definite record of the species being bred from the stems.

Injury and Abundance.

In Connecticut the injury caused by the adults and larvæ is confined entirely to the new growth and nuts, causing the stems, in extreme cases, to be killed entirely back to the old wood and causing the nuts to fall off before maturing.

The adults do their chief damage early in the spring, making large punctures (see plate IV, a), some of which cut half way through the leaf stems and young shoots, causing them to wilt and die, and although the main injury is done by the larvæ, the adult injury would be worth considering.

The larvæ work first in the young shoots and, later, as the stems grow, in the petioles of the leaves, in the leaf stems, or, in fact, any part of the new growth large enough to accommodate the larvæ. This injury to the new shoots by the larvæ, most severe in early summer and up to the middle of June, has been so great in the plantations of Dr. Morris at Stamford and also with the trees at Lyme, as to wholly prevent the owners from

obtaining a crop of nuts. Plate IV, b, shows the injury caused by the larvæ.

Juglans sieboldiana and *J. cordiformis* seem to be the ones preferred, and we have counted as many as eight larvæ in a stem four inches long, and have seen trees where every stem was completely tunneled out. The work can be detected by the egg puncture and by the frass which is pushed out through it as the larva grows.

From what we can learn through correspondence with other entomologists and nut growers, the damage caused by this insect is far more serious in Connecticut than in most other states. The fact that it is mentioned as breeding only in the nuts, and has not previously been recorded as attacking the new growth, would lead one to believe that it has not been very abundant, nor has caused much damage in other regions where nuts are grown.

The larvæ cause considerable injury to small trees in nurseries. For instance, in a nursery at New Haven, in August, out of forty-six three-year-old trees of *Juglans sieboldiana* and *J. cordiformis*, twenty-six were infested, some of them badly, by the larvæ tunneling in the new growth. On October 10th, the junior author examined thirty-five six-year-old trees of *J. sieboldiana* in another part of this nursery. Five trees showed larval attack but most of the year's growth was short and not vigorous, and consequently not favorable for the attack of this insect. In the same nursery, there had been considerable fall feeding at the base of the leaf petioles by the newly-emerged adults, but no beetles could be found on the trees nor underneath the stones upon the ground nearby.

In a nursery at New Canaan, about the middle of September, Mr. Kirk noticed a row containing about 265 trees of *Juglans sieboldiana* on all of which the larvæ were tunneling in the new growth. An adjoining row of about the same number of *J. regia* trees was only slightly attacked, and another adjoining row containing about 400 trees of black walnut, *J. nigra*, were uninfested. Several hundred other trees of *J. sieboldiana* in another part of the same nursery were badly infested, not a single tree escaping. Here, also, was noticed the fall attacks of the adults at the base of the leaf petioles, and two adults were collected.

What appeared to be the work of this weevil was received from Litchfield July 7th, and showed the characteristic feeding punc-

LIFE HISTORY AND HABITS.

This insect has only one generation each year and passes the winter in the adult stage, though we were not able to discover the exact place of hibernation.

The beetles appear usually the latter part of May, and begin at once to feed upon the stems and leaf veins. After mating, the females begin about the last week in May to lay eggs. Apparently the beetles feed throughout the egg-laying period, as both collected and bred adults died within one or two days when left in captivity without food, but when given food they lived for a month. The beetles have the habit common to most curculios of feigning death and dropping from the stems when disturbed.

The eggs are laid on both fruit and stems in irregular crescent-shaped punctures and under flaps, similar to those of the plum curculio, *C. nenuphar,* and hatch from six to twelve days later, depending probably upon weather conditions. Eggs are laid throughout the period extending from the last week in May up to the first of August. Those laid after about July 20th hatch, but do not mature, the larvæ dying in the stems, probably because of the hardening of the plant tissues. During August many dead larvæ were observed in the stems, but no living larvæ were seen after September 1st.

The young larvæ first attack the young shoots, then the base of the leaf stems, then with some species of *Juglans* the other portion of the leaf stem is injured and finally the nuts. In the stems they work mostly upwards but are found tunneling in both directions. The moults were not observed. From one to five larvæ to each nut have been observed in butternuts, where they go into the kernel but return to the shucks to complete their larval life. From four to six weeks are required for the larval development, which does not continue in the stems after September 1st.

When mature, the larvæ enter the ground about one inch below the surface, remain there about ten days, when they pupate. From sixteen to twenty days after pupating the adults emerge and, flying to the trees, eat small holes, chiefly at the base of the leaf petioles.

The feeding habits of the newly-emerged adults might easily mislead one to conclude that the beetles were ovipositing. The

first pupæ are seen about August 1st, and the last adults are seen about September 16th. Our latest record of adults which had laid eggs earlier in the season was September 7th.

Dr. Morris informs us that he had observed adults at work on the trees as early as May 7th and as late as September 5th.

Description.

Egg. The egg is oblong oval in shape and of a creamy white color and apparently with a smooth surface, but when examined, under high power, it has a finely wrinkled appearance. Length, .95 mm.; thickness, .57 mm.

Larva. The larvæ are cylindrical and legless with no prominent markings or appendages. When young they are of a dirty white color with brown heads, and when mature the body changes to a yellowish white color. Tips of mandibles black, prothoracic segment with a brown patch nearest the head, and tubercles brown. Length of full grown larva, 12 mm.; thickness, 3½ mm.

Pupa. There is no pupal cell, the pupa being entirely naked. It is of the same general form and size of the adult and of the same yellowish white color of the full grown larva. There are a few long, slender, brown hairs on the beak, thorax and ventral side of the abdomen and two on each femur, with two prominent stouter spines on the last abdominal segment.

Adult. The adult very closely resembles the plum-curculio, *C. nenuphar*, but is readily distinguished by its larger size and the more distinct, broad, whitish band on the elytra. The beak is about one-half and the thorax one-third as long as the body. The elytra have several humps and ridges which give the beetle a rough appearance. The whole is covered with short, yellowish hairs, forming the bands on the thorax and elytra. The newly-emerged specimens are distinctly brownish in tint, but after a time turn to a darker grey color. This serves to distinguish the newly-emerged from the egg-laying adults. The length of *C. juglandis* varies from .24 to .28 of an inch, while that of *nenuphar* does not exceed .22 of an inch.

This weevil was originally described by Dr. J. L. LeConte in Proceedings of the American Philosophical Society, Vol. XV, page 226, 1876, as follows:

C. juglandis n. sp.

"Dark brown, varies with black, pubescence fulvous, or dirty yellow, forming a curved bifurcated line each side of the prothorax, and a broad band behind the middle of the elytra. Beak longer than the head and prothorax, cylindrical, not stout, shining, sparsely punctured, with a broad lateral groove, and two stout, finer ones near the base. Prothorax coarsely punctured and rugose, with a very short carina before the middle, and four discoidal tubercles; broadly constricted in front. Elytra with striæ with large quadrate punctures, alternate interspaces strongly costate, the third and fifth interrupted forming on each a high crest, with a basal and sub-apical elevation. Ventral segments sparsely punctured, fifth more finely and densely. Legs somewhat annulated, thighs bidentate. Length, 7 mm.; .27 inches.

This species is closely allied to the plum weevil, *C. nenuphar*, and has been confounded with it until the present time. It is, however, much larger, the beak is longer, more slender, and less curved; the prothorax is broader and more rounded on the sides, the crest of the fifth elytral interspace is longer, almost as large as that of the third, and overlaps it far more than half its length, and, finally, the pubescence is of a nearly uniform color, so that the band of the elytra is not variegated with white. The ventral segments are much less densely punctured."

Food Plants.

From our studies and observations, it is evident that in Connecticut the walnut weevil attacks and injures the various species of *Juglans* in the following order, those at the head of the list being most seriously injured.

Juglans cordiformis,	Heartnut,	Fruit and Stems.
" *sieboldiana,*	Siebold's walnut,	" " "
" *cinerea,*	Butternut,	" " "
" *regia,*	Persian or English walnut,	" " "
" *nigra,*	Black walnut,	Stems.
" *mandshurica,*	Japanese walnut,	"

Though we have no definite records of this weevil attacking and injuring the hickories, Mr. Kirk observed punctures at the base of the leaf stems resembling closely the feeding punctures of *C. juglandis* on *Juglans*. Dr. Morris states that he has seen them on the bitternut, *Hicoria minima*, the shellbark, *H. ovata*, and the mockernut, *H. alba*. No doubt they may attack the stems of certain hickories, and the stems and nuts of practically all

species of *Juglans*, yet they seem to prefer and only injure a few species of the latter.

Experiments in Determining Life Stages and Habits.

Adults were placed in cages made of cheese cloth sewed into a cylinder-shaped bag and slipped over the new growth and tied at both ends, to determine the habits of the adults.

The weevils were collected from the neighboring trees, immediately placed in the cheese cloth cages and were examined twice or three times a week. The adults did considerable feeding before making the egg puncture, by stripping the bark on the leaf veins and stems to such an extent that we thought it advisable to try an arsenical poison to kill them before ovipositing.

The egg and pupa stages were studied in the Station insectary. The length of the egg stage was determined by cutting off the shoots immediately after eggs were laid, and taking them to the insectary, where they were kept fresh and were examined each day until the eggs hatched.

The larvæ were studied in the field in both the stems and the nuts. Stems were marked and labeled where eggs had just hatched and the cheese cloth bags were tied over the stems to trap the larvæ when they emerged, giving the length of the larval stage. Larvæ were taken from these cages and placed in cages in the insectary, where the pupa stage and time of adults emerging were determined.

The habits of the newly-emerged beetles were studied in the field.

Control Methods.

After observing the extensive feeding habits of the adults, we were able to ascertain a probable preventive in the use of lead arsenate. Several small trees were sprayed with lead arsenate, six pounds to fifty gallons, and weevils were collected and encaged on the sprayed stems.

On June 11th, three cages were made on a tree sprayed with the above proportions; two cages containing two weevils each and the other, four weevils. Check cages were made on unsprayed trees. By June 18th all the weevils were dead in the cages and no eggs were laid and all stems showed the character-

istic feeding marks of the adults. In the unsprayed cage one weevil was dead by the 18th, while the other fed and oviposited until July 9th.

At Lyme, Conn., June 21st, two other cages were made, with three weevils each, on a Japanese walnut tree in bearing, sprayed with the same proportions of lead arsenate; two eggs were laid the following day, but the weevils were found dead a week later and there were no more punctures. The trees were examined later (August 10th) with the result that no more punctures were made after the trees were sprayed, although weevil work was apparent from eggs which had been laid before the application. Four adjoining trees showed considerable weevil injury and larvæ were still working in stems and nuts; while in the tree sprayed no larvæ were found.

Several other tests were made on a black walnut tree on the Station grounds, with similar results.

In one nursery, cutting off the infested shoots in mid-summer, say about June 20th, is practiced. The tree afterwards makes a good growth and the shoots are not seriously injured by the weevils, late in the season.

This pruning must not be done too late, however, else the new growth will not ripen sufficiently and will be winter-killed.

In any spraying work to control the walnut weevil, the spray should be directed against the under surface of the leaves in order to kill as many as possible of the adults which feed there on the leaf veins.

Distribution in North America.

Apparently this weevil occurs at least throughout the eastern half of the United States and Canada, though in a large portion of this territory it is not abundant and is not considered an important pest. In order to obtain definite records of its occurrence some sixty letters were sent to specialists, station and museum entomologists, horticulturists and nut growers, asking for the records on the specimens in their collections and for the results of their field observations regarding this insect. About fifty-one replies were received, from which the following records of distribution are compiled. The names given are in most cases not those of the collector, but of those reporting the records to us.

ALABAMA: Andalusia (Bur. Ent. coll., Wash., D. C., A. L. Quaintance).
CANADA: Belleville, Ont. (coll. of J. D. Evans, Trenton, Ont.).
Hamilton, Ont., Ridgeway, Ont. (Ont. Agr. College coll., Guelph, Ont., C. J. S. Bethune).
Montreal (Colo. Expt. Sta. coll., Ft. Collins, Colo., C. P. Gillette).
Mount St. Hilaire, Mont. (coll. G. Chagnon).
Ontario (Am. Mus. Nat. Hist. coll., N. Y. City, C. W. Leng).
Ottawa (coll. of W. H. Harrington, Ottawa, Can., A. Gibson).
Ridgeway, Ont. (coll. of J. D. Evans, Trenton, Ont.).
Laval County (Can. Dept. Agr. coll., Ottawa, Can., A. Gibson).
Toronto, Ont. (Cornell Univ. coll., Ithaca, N. Y., G. W. Herrick).
CONNECTICUT: Lyme (coll. of A. B. Champlain, Harrisburg, Pa.).
Lyme (Conn. Expt. Sta. coll., New Haven, Conn.; collected by A. B. Champlain and H. B. Kirk).
New Canaan (Conn. Expt. Sta. coll.; collected by B. H. Walden).
North Branford (Conn. Expt. Sta. coll.; collected by H. B. Kirk).
Stamford (Am. Mus. Nat. Hist. coll., N. Y. City, C. W. Leng).
Stamford (Bur. Ent. coll., Wash., D. C., A. L. Quaintance).
Stamford (Conn. Expt. Sta. coll.; collected by H. B. Kirk).
Stamford (U. S. Nat. Mus. coll., Wash., D. C., E. A. Schwarz).
DISTRICT OF COLUMBIA: Washington (U. S. Nat. Mus. coll., E. A. Schwarz. Listed by Ulke).
Washington (Ohio State Univ. coll., Columbus, O., H. Osborn).
GEORGIA: Clayton (Am. Mus. Nat. Hist. coll., N. Y. City, C. W. Leng).
Santa Catherina Island (U. S. Nat. Mus. coll., Wash., D. C., E. A. Schwarz).
ILLINOIS: Galesburg (Am. Mus. Nat. Hist. coll., N. Y. City, C. W. Leng).
Central Illinois (observed by H. Garman).
Northern Illinois (Ill. Expt. Sta. coll., Urbana, Ill., C. A. Hart).
Illinois (mentioned by B. D. Walsh).
INDIANA: Elkhart (Mich. Expt. Sta. coll., East Lansing, G. D. Shafer).
Harrison County (Ind. Expt. Sta. coll., Lafayette, Ind., J. Troop).
Posey County (Ind. Expt. Sta. coll., Lafayette, Ind., J. Troop).
Southern Indiana (Ind. Expt. Sta. coll., Lafayette, Ind., J. Troop).
IOWA: Guttenberg (U. S. Nat. Mus. coll., Wash., D. C., E. A. Schwarz).
Iowa (Mus. Comp. Zool. coll., Cambridge, Mass., S. Henshaw).
KANSAS: Douglas County (Univ. of Kan. coll., Lawrence, Kan., S. J. Hunter).
LOUISIANA: Mound (Bur. Ent. coll., Wash., D. C., A. L. Quaintance).
MARYLAND: Plummer's Island (U. S. Nat. Mus. coll., Wash., D. C., E. A. Schwarz).
Maryland (Minn. Expt. Sta. coll., St. Anthony Park, Minn., A. G. Ruggles).
MASSACHUSETTS: Mass. (coll. of H. C. Fall, Pasadena, Cal.).
NEBRASKA: (Indications but no definite record, L. Bruner).

NEW JERSEY: Newark (N. J. Expt. Sta. coll., New Brunswick, N. J., H. B. Weiss).
Orange Mts. (U. S. Nat. Mus. coll., Wash., D. C., E. A. Schwarz).
South Orange (Am. Mus. Nat. Hist. coll., N. Y. City, C. W. Leng).
New Jersey (Mus. Comp. Zool. coll., Cambridge, Mass., S. Henshaw).
NEW YORK: Buffalo (U. S. Nat. Mus. coll., Wash., D. C., E. A. Schwarz).
Buffalo (Univ. of Kan. coll., Lawrence, Kan., S. J. Hunter).
Ft. Montgomery (Am. Mus. Nat. Hist. coll., N. Y. City, C. W. Leng).
Newport (New York State Mus. coll., Albany, D. B. Young).
New York City (U. S. Nat. Mus. coll., Wash., D. C., E. A. Schwarz).
*New York City (Bur. Ent. coll., Wash., D. C., A. L. Quaintance).
Peekskill (Cornell Expt. Sta. coll., Ithaca, N. Y., G. W. Herrick).
Phoenicia (N. Y. State Mus. coll., Albany, N. Y., D. B. Young).
Poughkeepsie (N. Y. State Mus. coll., Albany, N. Y., D. B. Young).
Westchester (Injury observed by W. C. Deming).
New York (U. S. Nat. Mus. coll., Wash., D. C., E. A. Schwarz).
New York (Am. Ent. Soc. coll., Phila., Pa., H. Skinner).
New York (coll. of H. C. Fall, Pasadena, Cal.).
New York (Mich. Expt. Sta. coll., East Lansing, G. D. Shafer).
NORTH CAROLINA: Magnetic City (Bur. Ent. coll., Wash., D. C., A. L. Quaintance).
Round Knob (U. S. Nat. Mus. coll., Wash., D. C., W. D. Pierce).
North Carolina (Mich. Expt. Sta. coll., East Lansing, G. D. Shafer).
OHIO: Cincinnati (Am. Mus. Nat. Hist. coll., N. Y. City, C. W. Leng).
Sugar Grove (Expt. Sta. coll., Wooster, O., H. A. Gossard).
PENNSYLVANIA: Allegheny (Ill. Expt. Sta. coll., Urbana, Ill., C. A. Hart).
Allegheny (Mus. Comp. Zool. coll., Cambridge, Mass., S. Henshaw).
Allegheny (Am. Mus. Nat. Hist. coll., N. Y. City, C. W. Leng).
Bethlehem (Lab. Econ. Zool. coll., Harrisburg, Pa., A. B. Champlain).
Harrisburg (Lab. Econ. Zool. coll., Harrisburg, Pa., A. B. Champlain).
Jeanette (reported by Mr. Klages).
Pittsburg (reported by Mr. Klages).
Pottstown (Wagner Inst. coll., Phila., Pa., A. B. Champlain).
Winewood (Bur. Ent. coll., Wash., D. C., A. L. Quaintance).
Dauphin County (reported by Dr. Castle).
Lancaster County (reported by Dr. Castle).
Penn., Southwestern (reported by Dr. John Hamilton).
Penn. (U. S. Nat. Mus. coll., Wash., D. C., E. A. Schwarz).
TEXAS: Texas (Mich. Expt. Sta. coll., East Lansing, Mich., G. D. Shafer).

* These specimens were collected by Dr. R. T. Morris and may have been taken on his farm at Stamford, Conn.

VERMONT: Burlington (Boston Soc. Nat. Hist. coll., Boston, Mass., C. W. Johnson).

VIRGINIA: *Hume (Bur. Ent. coll., Wash., D. C., A. L. Quaintance).*
Pennington Gap (U. S. Nat. Mus. coll., Wash., D. C., E. A. Schwarz).
Petersburg (Bur. Ent. coll., Wash., D. C., A. L. Quaintance).
Virginia, Southwestern (observed by W. J. Price).
Virginia (Am. Ent. Soc. coll., Phila., Pa., H. Skinner).

WEST VIRGINIA: Berkeley (U. S. Nat. Mus. coll., Wash., D. C., E. A. Schwarz).
French Creek (Expt. Sta. coll., Morgantown, W. Va., W. E. Rumsey).

WISCONSIN: Wis. (N. Y. Expt. Sta. coll., Geneva, N. Y., P. J. Parrott).
Wis. (Mus. Comp. Zool. coll., Cambridge, Mass., S. Henshaw).

Many experiment station collections contain no specimens of the walnut weevil. A few have material from their own state. Others have specimens from adjacent or distant states, and the existence of such specimens is frequently unknown to the entomologists now working in the states where the beetles were collected. We mention this to show that in all probability this weevil is not as abundant throughout the range of *Juglans* as in Connecticut, or it would have been collected more extensively, and had it caused much damage it would probably have been studied elsewhere.

Several entomologists and collectors report no records for their states, but such data were furnished by others.

Reports were received from Professors A. J. Cook, R. W. Doane, and H. C. Fall, California; Professor C. P. Gillette, Colorado; Professor C. O. Houghton, Delaware; Dr. E. W. Berger and Professor J. R. Watson, Florida; Professor J. M. Aldrich, Idaho; Professor H. Garman, Kentucky; Dr. Edith M. Patch, Maine; Geo. D. Shafer, Michigan; A. G. Ruggles, Minnesota; Professor Leonard Haseman, Missouri; Professor R. A. Cooley, Montana; Professor W. C. O'Kane, New Hampshire; Professor C. E. Sanborn, Oklahoma; Professor A. B. Cordley, Oregon, and Professor A. L. Melander, Washington; but there are no records or observations to indicate that *Conotrachelus juglandis* occurs in these states. No reports have been received from Arizona, Arkansas, Mississippi, Nevada, New Mexico, North Dakota, Rhode Island, South Carolina, South Dakota, Tennessee, Utah and Wyoming.

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THE WALNUT BUD-MOTH.

Acrobasis caryæ Grote?

By H. B. Kirk.

While studying the walnut weevil on the plantation of Dr. Robert T. Morris at Stamford (see page 240) nests of lepidopterous larvæ were noticed on the tips of the branches of Persian walnut, *Juglans regia,* trees. Closer examination revealed larvæ tunneling in the buds and new shoots and causing about as much damage as the weevil itself.

This insect was observed more than three years ago by Dr. Morris, who wrote in July, 1909, as follows:

"By the way, I will enclose some newly discovered bud-worm work and of very serious character, as it comes at a season when my men are not looking out for bud-worms. I send under separate cover three shoots from a young *Juglans regia* (the only shoots which it had) all headed off by the bud-worm. In May the bud-worms badly injured *Juglans cardiformis, J. sieboldiana, J. australis, J. mandshurica, J. regia, J. nigra, J. rupestris,* and *J. Californica:* also *Hicoria ovata, H. laciniosa,*

H. pecan and several hybrids. They are particularly fond of *J. cordiformis.* Some trees of this species five years old and about ten feet high had practically every terminal bud infested this spring."

A month later Dr. Morris wrote:

"Under separate cover I am sending specimens of *Juglans cordiformis* showing work of a new lot of bud-worms. This makes the third brood apparently for this season, if all are of the same species. Bud-worms are going to do terrible damage among my thousands of young nut trees."

In 1911 Dr. Morris regarded the bud-worms as the larvæ of the walnut weevil, *Conotrachelus juglandis,* therefore his statement regarding damage should be modified, as some of the injury to the various species of walnut and hickory about which he wrote in 1909 was undoubtedly caused by the weevil instead of the bud-worm. In the studies herein described, the Persian walnut, *J. regia,* was more seriously injured than any other species observed.

Extent of Injury.

The damage done by this insect, shown on plate VIII, is fully as great as that of the weevil itself, and although there are not as many species of trees affected, the most valuable species, *J. regia,* is the one preferred. In our observations on Dr. Morris' farm the damage to the above species of walnut has been greater than that of *C. juglandis,* and in a number of cases has killed the young trees in a very short time.

The young butternuts, black walnuts and several varieties of the English or Persian walnuts, *J. regia,* were also damaged seriously. On one tree, two feet high, thirty-five pupæ were found in the nests. This tree and several others not so badly infested were killed. So far as can be determined, it does not attack, or at least does not seriously injure, any of the other species of *Juglans.*

This insect has been studied and observed only at Stamford, though indications of its presence were noticed late in the season at New Canaan.

Habits and Life History.

There are at least three generations each season. The eggs are laid singly around the base of the bud and sometimes on the

leaves, are not concealed and, though small, can easily be detected on infested trees. The first brood was not discovered until in the pupa stage, when an idea of the damage was first brought to our attention.

Adults that were bred June 28th from these pupæ laid eggs two days later. These eggs hatched in from six to ten days. Calculating from the period necessary for the development of the second brood, the first eggs are laid about the second week in May. Eggs of the third brood are laid about August 15th to 22d. When the larvæ of the third brood were first discovered (August 23d) they were about an eighth of an inch in length, and when examined September 7th, they were found in the old nests of the previous brood and apparently had not increased in size. No observations were made after this date, but the young larvæ probably pass the winter in the old nests.

The larval habits of this insect are quite varied, feeding on the buds, leaves, and stems. The stem-feeding habit is most peculiar; sometimes the feeding is from the outside and only on one side of the stem, while again the larva begins on the terminal or an axillary bud and commences feeding downward, being entirely concealed all the while.

On account of this latter habit the work of this species and that of the walnut weevil was at first thought to be caused by one species of insect. But even with this similarity, the work of the two species can readily be distinguished. The larva of the walnut weevil exudes its frass by pushing it out from the egg punctures at the base of the petioles or along the stem, but never at the terminal end of the new shoot. In the work of the present species the tips of the shoots die and the frass is retained and afterward forms a part of the pupal case, and again the nests are always apparent with the frass and leaves drawn together where the majority of the pupal cases are found.

The nest, which is the most conspicuous evidence of the presence of this insect, contains most of the pupæ. The remaining few are found in the dried tips of the stems or in the green stem itself. From two to three weeks after pupating the adults emerge.

Adults, bred in the laboratory, laid eggs several days after emerging and died shortly after. The egg and adult stages of this insect are shown on plate IX.

Identity of the Bud-Moth.

Several fresh-reared adults were submitted to Mr. Charles R. Ely of Washington, D. C., a specialist in this group. Mr. Ely, on first examination, considered this a new species, and remarked that, according to his memory, the pupa cases were quite different from those of *Acrobasis caryæ* Grote, to which the adults bore a close resemblance. It is recognized that in the genus *Acrobasis* adults of certain species can be separated only by a knowledge of the food habits of their larvæ.

Mr. Ely afterward examined the material in the U. S. National Museum and, in company with Dr. H. G. Dyar, compared our specimens with those labeled *A. caryæ* Grote in the collections. They seemed to be identical. Mr. Ely states, however, that the specimens in the museum are not really proved specimens of *A. caryæ* as their larval habits are not known, and furthermore that the adults appear different from the others which were bred from pecan. For the present, therefore, we must refer to this bud-worm of the walnut as *A. caryæ* Grote, but on further investigation it may prove to be an undescribed species.

Description.

Egg. Irregularly oval, greenish white, surface finely wrinkled, .57 mm. long and .34 mm. wide.

Larva. The larva is cylindrical, tapering slightly toward both ends, and is sparsely covered with long hairs. There are no prominent markings; tubercles indistinct. Mouth parts and body of a dirty olive green color, head shining black and on the dorsal side of the first segment is a black patch with a smaller black spot on either side, the larger patch being divided in the middle by a line the same color as the body. Second segment marked with two small black dots; legs in front, black. Length, five-eighths of an inch; thickness, one-eighth of an inch.

Pupa. About seven-sixteenths of an inch in length, distinctly tapering. Light brown in color with no striking markings. Anal extremity with a short, sharp spine on either side pointing outward and four slender hooked spines at posterior end. Abdominal segments finely and moderately densely punctured.

The pupa is enclosed in a cylindrical-shaped case about one-half inch long and about three-sixteenths of an inch in diameter.

It is composed chiefly of frass of the larva. Sometimes a number of cases are welded together in one mass, but the general shape is the same.

Adult. The adult is a grey moth having a wing-expanse of about three-fourths of an inch but showing much variation in size. The primaries are ash-grey or darker, with lighter basal areas and a light grey suffused area on distal third of front margin extending scarcely half-way across the wings, more or less iridescent. Secondaries unicolorous and in most cases lighter than the primaries.

Acrobasis caryæ, which is probably identical with the walnut bud-moth, was originally described by A. R. Grote in *Papilio,* Vol. I, page 13, February, 1881. The description is reprinted here, and is as follows:

Acrobasis caryæ n. s.

"Male. The maxillary palpi untufted, the antennæ ciliate, with a sub-basal flexure and a scale-tooth on the thickly scaled basal joint. Shining grayish fuscous; the head and thorax concolorous. Smaller than *Angusella,* without the carneous shadings and reddish thorax and head. Outer line of primaries pale, narrow and faint. Inner line a ridge of raised darker scales narrowly edged outwardly by a pale, flesh-colored shade. The wing is paler, more grayish, at base. The color shifts with the light. Discal points faint. In ornamentation this species is inconspicuous. Hind wings, as usual, blackish; fringes interlined, concolorous. Length of primary wing, 9 mil. Reared by Mr. Coquillett from larvæ on *Carya porcina;* the larva has been found 'boring into the twigs.'"

Mr. Coquillett describes the larva and chrysalis as follows:

"Body subcylindrical, smooth, pale greenish ash; a pale brown subdorsal dot on each side of segment 2; a wavy-fold below the spiracles; the latter are encircled with a dark brown ring, and there is a brown piliferous dot above each; a few whitish hairs on each side of the body; top of segment 1 polished, yellowish green; head narrower than segment 1, heart-shaped, dark brown; venter pale green, unmarked; 16 legs; length 14 mm. Found May 21, burrowing in the branches of the pignut hickory, *Carya porcina,* usually selecting the lower branches; imagoes about June 22.

Chrysalis. Of the usual form, pale brown, rounded at the posterior end, at which place there is a cluster of about four slender hooked spines; length, from 7 to 8 mm. The larva spins a thin web around the footstalks of the leaves which grow near the terminal end of the branch, and then burrows into the terminal bud and the wood of the present year's growth. It webs its castings together and forms a short

tube which projects outward from the mouth of its burrow, and is closed at the outer end. The larva probably assumes the chrysalis form in its burrow, but those which I reared deserted their burrows and spun tough cocoons beneath the litter in the bottom of the breeding-cage. These larvæ are very subject to the attacks of parasites; from a small number which I collected I obtained three moths and two Hymenopterous parasites which Mr. E. T. Cresson determined to be the *Phanerotoma tibialis* of Haldeman. One of these parasites issued June 21 and the other June 26."

Natural Enemies.

Two Tachinid flies were reared from the second brood of larvæ, emerging August 1st. These have been determined by Mr. Harrison E. Smith of the Bureau of Entomology as *Exorista pyste* Walk.

Remedies.

The larvæ feed mostly on the leaves which are drawn into the nest and this pest can therefore be easily controlled by an arsenical spray applied to the foliage. On the trees sprayed with lead arsenate (six pounds in fifty gallons of water) for the adults of the walnut weevil no bud-worm injury was noticed. Most all of Dr. Morris' trees, especially the Persian or English walnut, were infested with both the weevil and the bud-moth, so that both insects could be controlled with the same applications. The larvæ of the three broods appeared this season about June 1st, July 10th and August 18th. The weevil is most abundant after June 1st, so if applications are made on the first two dates the bud-moth would be controlled and a large percentage of the weevils destroyed. However, if the weevils are abundant, a second application should be made two weeks after the first. Further trials are necessary to establish practical control methods for this insect, but it is probable that less poison, perhaps three pounds in fifty gallons of water, may prove effective against the bud-moth as well as against the walnut weevil.

Literature.

Grote, A. R. *Papilio*, Vol. I, p. 13, 1881. (*Original description of adult, larva and pupa.*)

Hulst, G. D. Transactions American Entomological Society, Vol. XVII, p. [illegible], 1890. (Description of adult, larva and pupa.)

Dyar, H. G. Proceedings Entomological Society, Washington, Vol. X, [illegible]

THE MOSQUITO PLAGUE OF THE CONNECTICUT COAST REGION AND HOW TO CONTROL IT.*

The salt marshes along the coast furnish the principal part of the mosquito plague of the southern portion of the State. Contrary to the habits of most mosquitoes, those of the salt marsh species fly inland long distances, and as they are large and very abundant, and are voracious feeders, they make life a burden to many inhabitants, and keep away many others who would otherwise summer on the Connecticut coast. This condition results in preventing the proper development of a legitimate business and the people of the State are so much the poorer on account of it. That the remedy is not impossible, nor impracticable, nor so expensive as most people suppose, and that for agricultural purposes the land is greatly improved by the treatment, the details given on the following pages will show:—

MOSQUITOES OF THE SALT MARSH.

There are two species of mosquitoes which breed abundantly on the salt marshes and which are commonly called salt marsh mosquitoes—the brown salt marsh mosquito *Culex cantator* Coq. and the banded salt marsh mosquito *Culex sollicitans* Walk.

THE BROWN SALT MARSH MOSQUITO.

The brown salt marsh mosquito *Culex cantator* Coq. is large and uniformly reddish brown in color without conspicuous markings, though there are narrow white bands on the legs and on the abdomen. It is shown in figure 1. Breeding upon the salt marsh early in the season, the females bite fiercely and migrate long distances in search of food, going chiefly inland, which in Connecticut is the direction of the prevailing winds. About July 1st, it is almost or wholly replaced by the banded salt marsh mosquito, which is present during the remainder of the season.

THE BANDED SALT MARSH MOSQUITO.

On account of its white markings this is the most conspicuous mosquito of medium size found in Connecticut. All of the legs are banded, dark and white alternating, and the front margin of each abdominal segment is also white and there is a dorsal longitudinal white line on the abdomen. In addition to these striking

* [illegible]

characters there is a white band upon the beak, about half way between base and tip, and these markings together serve to distinguish this from all other species of mosquitoes.

The eggs are laid on the mud of the salt marsh pools and hatch when the pools fill with water. About a week is required in warm weather from the hatching of the egg to the emergence of the adult mosquitoes, which come in swarms or broods and

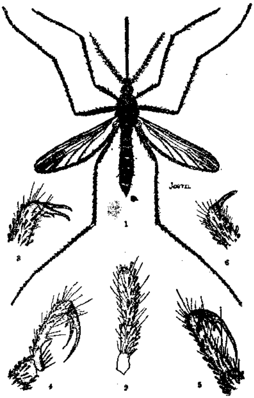


FIG. 1.—The brown salt marsh mosquito, *Culex cantator* Coq.: 1. adult female: 2. palpus; 3. anterior claw of same; 4. 5. 6. anterior, median and posterior claws of male. All enlarged. (After Smith, Report on New Jersey Mosquitoes.)

are often extremely abundant, and the females bite ravenously. They migrate inland in search of food, sometimes going twenty-five or thirty miles. It seems to be necessary for the females to obtain blood from one of the higher animals in order to develop their eggs. Most of them are probably able to obtain food within from five to ten miles of their breeding places.

The banded salt marsh mosquito is far more abundant than the brown salt marsh species, and appearing later in the summer, constitutes the mosquito plague of the shore region, remaining

until cool weather prevents further mosquito breeding. This mosquito is the one commonly called the salt marsh mosquito and is shown in figure 2.

Of course there are several species of fresh water mosquitoes of the genus *Culex*, and malarial mosquitoes, *Anopheles*, breeding in the fresh water pools in the rear of nearly every salt water marsh, and rain barrel mosquitoes breed in the cisterns and

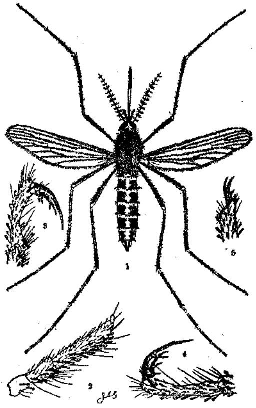


FIG. 2.—The banded salt marsh mosquito, *Culex sollicitans* Walk.: 1. adult female; 2. palpus; 3. anterior, 4. median and 5. posterior claws of male. All enlarged. (After Smith, Report on New Jersey Mosquitoes.)

other receptacles around the shore cottages, but these are local and do not fly far. They do not as a rule breed in salt or brackish water, and do not constitute any important part of the mosquito plague of the Connecticut coast region.

AREA OF SALT MARSH IN CONNECTICUT.

The salt or tide water marshes of Connecticut contain 22,264 acres or 34.79 square miles,* distributed rather unevenly, along

* D. M. Nesbit, Miscellaneous Special Report No. 7. The Marshes of

the coast in the southern part of the State. The marsh areas are the most extensive in the middle part of the coastal region, or that portion bounded on the west by the Saugatuck and on the east by the Connecticut rivers. A considerable portion of the coast is hard land, being gravelly or rocky and there are few large tidal marshes, the largest in the whole state being the Quinnipiac marsh, near New Haven, of over 3,600 acres in extent.

CONDITION OF THE SALT MARSH AREAS.

In the report of the Mosquito Survey of Connecticut, made in 1904, and published in the report of this station for that year, page 285, it was stated that fully 50 per cent. of the entire salt marsh area of the State had at some time been thoroughly drained for salt hay farming. Other portions are well drained naturally, and so are not serious breeders of mosquitoes.

In recent years, however, salt hay farming seems to have been neglected, though it is hard to understand why; as the hay still brings a price ranging from $7.00 to $12.00 per ton, and there is quite a demand for it for packing, bedding and mulching material. Many salt marshes have been neglected, the old ditches have become clogged, filled or grown up and few new ones have been cut. Such marshes are prolific breeding places of salt marsh mosquitoes. From personal observations, and from conversation with some of the older residents, we may safely conclude that in many cases at least the marshes are in worse condition to-day than they were thirty or forty years ago and mosquitoes correspondingly more numerous. Wherever the marsh becomes sufficiently congested, water stands, the turf rots and a depression is formed which increases in size and breeds millions of mosquitoes.

Nearly every salt marsh receives more or less fresh water from springs or streams emerging from the highland. This water must pass through the marsh to reach the ocean. Some marshes are so congested that the fresh water cannot drain off but is kept back, making soft bogs with considerable stagnant water. Often the highest and dryest part of the salt marsh is near the outlet, while the lowest portion is at the back side next to the highland. In such places, and often nowhere else upon the marsh, stagnant water occurs

Many persons think that if tide gates are provided, it will prevent mosquito breeding, and that no other work is necessary. But the gates keep out only tide water. Fresh water enters just the same and must be allowed to pass out. Hence drains are necessary. Tide gates only prevent the flooding of the marsh at high tide and are almost negligible so far as mosquito breeding is concerned. It is necessary to do almost as much ditching with as without a tide gate. Wherever the tide rises and falls in the ditches, mosquitoes will not breed.

Tide gates are of much value in salt hay farming, for they keep the marshes from becoming flooded at each perigee tide, and prevent the salt grass from becoming encrusted with salt. Hay is considerably more valuable and a much greater yield is obtained if the salt water is not allowed to flood the marshes during the growing period.

Some communities, however, have recently made a start toward improving the conditions of the marshes. Nearly seven miles of coast marsh land was drained in 1911, just east of Stamford, and the present season similar work is being done about Greenwich, Fairfield, New Haven, Branford and Saybrook. This draining has all been for the purpose of doing away with mosquitoes, and not for increasing the yield of grass, yet the latter result is gained.

MOSQUITO CONTROL.

The general methods of mosquito control are (1) draining of the marshes, (2) oiling the breeding pools and (3) screening of rain water receptacles. The first, viz. draining, is the method to be chiefly considered in connection with the present control of the mosquito nuisance; the second may be employed temporarily until the draining can be carried out, and the third should receive attention each year.

METHODS OF DRAINING.

Where there is a natural stream flowing through the center of the marsh, the area may be satisfactorily drained by cutting simple lateral ditches running nearly at right angles to the axis of the stream, with the outlets bearing slightly toward its mouth.

These lateral ditches should be narrow—not more than ten inches wide—and from 24 to 30 inches deep, according to the character and size of the area to be drained. If there is no stream for an outlet, then a broad central ditch must be cut. This should be fully as deep as the laterals and wide enough to carry off the water supplied by them. The lateral ditches should be parallel with each other and from one hundred to one hundred and fifty feet apart, according to the condition of the marsh. It is not necessary to connect each pool with the tide water in ditching, as the seepage is so great through the porous peat of the salt marshes that pools are often drained and become dry at a distance of sixty or more feet from the ditch.

In draining some Connecticut marshes clay or gravel is encountered in the bottom of the ditch. It is not necessary to cut into this material unless it is near the central ditch where it will trap the water.

Ditches cut years ago for salt hay farming were shallow and open. Such ditches are not recommended and are not being cut at the present time in mosquito extermination drainage work. Shallow and open ditches are easily clogged by floating *debris* and vegetation grows in them readily, choking them and rendering them ineffective. Deep narrow ditches, on the other hand, remain in working condition for a number of years and are seldom clogged by vegetation. All marsh areas should be given attention, however, because in high tides, sods from the ditches, hay, driftwood or other *debris* may float into the ditches and clog them. By a frequent and systematic patrol of the area such conditions may be detected and remedied at once.

Such ditches as are mentioned above can best be cut with hand tools made for the purpose, shown on Plate XI, but on the larger marsh areas of New Jersey power machines may be employed to advantage.

There are always small depressions which should be filled and can be filled easier and cheaper than they could be drained. This is particularly true in the hard land. There are also certain depressions where on account of the expense draining is impracticable. These may be treated by dredging out the center and filling the banks with the material excavated, thus concentrating the water in a permanent pool which should be stocked with fish.

COST OF DRAINING MARSH LAND.

The cost of draining salt marsh land is not prohibitive. In fact it is actually less than most persons expect. From contracts which have been made recently for such work, and from conversing with the contractors, we may state that the salt marshes of Connecticut may be drained, so that they will not breed mosquitoes, at a cost of between \$5.00 and \$10.00 per acre, or say an average of not over \$8.00 per acre. As this area contains 22,264 acres the cost of draining the salt marshes of the whole State would not exceed \$178,112.00, a sum insignificant considering the benefit to be derived from its judicious expenditure.

Some contracting firms are prepared to drain marsh areas at a given price per running foot of ditch, the price varying from two cents upward, according to the amount and character of the work to be done.

On some of the large marsh areas of New Jersey, ditches have been cut by power machines at a price as low as one cent per running foot of ditch, and contracts have been made for draining certain definite areas at less than \$2.00 per acre.

RESULTS OF DRAINING SALT MARSH.

Wherever salt marsh is properly drained the land rises perceptibly, becomes much harder than before and there is no stagnant water upon it; mosquitoes cannot breed thereon, and consequently all land in the vicinity of the marsh becomes more desirable for residence purposes. If depressions occur and fill with water at flood tide, it will soon seep away before mosquitoes can develop in it. As the land becomes firmer it is easier to get over it, especially with a team, for cutting and removing the salt hay. The character of the vegetation soon changes and the spike grass *Distichlis maritima,* which is characteristic of breeding areas and which always produces a small yield of poor quality hay, gives way to black grass *Juncus gerardi,* which makes the best salt hay and which all over the marsh gives a much greater yield after draining. During the summer a practiced eye can tell at a glance, by the color of the marsh, which portions of it are well drained, showing the bright green of the black grass, contrasting with duller green or gray of the spike grass and the other marsh vegetation of the ill-drained areas.

The yield is often increased three or four fold by simple draining, and land has been known to produce twenty times as much after the operation.*

Such an increase in yield might, even with the crop of a single season, more than pay the cost of draining. But this increase keeps up as long as the drains work and the total increase in yield and quality of the crop is enormous.

This yield, of course, greatly increases the income from the land, which accordingly increases in value as an investment. Surrounding property also becomes more valuable on account of the increase in the value of the marsh.

That the growing of vegetable crops on the salt marsh, where properly drained and dyked, is not impossible, nor impracticable, was demonstrated a few years ago by Mr. F. R. Sammis of Stratford, who grew some excellent celery, asparagus and onions on the big Stratford marsh. In future years, unquestionably some of our salt marsh land will be used to grow such crops.

But more particularly on account of getting rid of the mosquito plague is the benefit felt by those living near the marsh. The people are more healthy and more comfortable. Shore resorts, summer hotels and cottages, as well as permanent residences, all benefit by such improvement work. If the mosquitoes can be eliminated from the coast region of Connecticut—and they will be if we drain the marsh land—there is no more attractive place in the country where one can spend the summer. Last but not least, the railroad and transportation companies will reap a harvest in the increased summer traffic to and from the shore resorts.

OILING OF BREEDING POOLS.

Where mosquito larvæ wrigglers are found in any pool, they may be killed in a few minutes by spreading a film of oil over the surface of the water. It is necessary for the larvæ to come to the surface about once each two minutes to breathe, and the oil not only prevents the air from entering their respiratory system, but the oil also enters their breathing tubes, destroying the tissues, and they soon die.

The oil must be applied about once each ten days to keep the

* J. B. Smith, Bulletin 207, New Jersey Agricultural Experiment

pool in a safe non-breeding condition. For this purpose ordinary kerosene, which can be purchased from any grocer, will answer. Some prefer a heavier oil, called light fuel oil. One grade sold by the Standard Oil Co. as "34° Distillate" has been recommended for this work.

Oiling at its best is but a temporary expedient, and should be practiced on the salt marsh only until the marsh can be drained. In mid summer the tall vegetation often obscures many small breeding places, and likewise makes it difficult to distribute the oil on the surface of the water, where needed,—most of it striking the vegetation.

A convenient method of applying oil is by means of small compressed air sprayers with cylinders of galvanized sheet iron. Each cylinder contains a pressure pump and will hold about two and one half gallons of liquid. It may be carried in the hand or held by a strap thrown over the shoulder. Such an outfit, including short piece of hose with nozzle, may be purchased for $4.50. A two-foot extension rod is almost a necessity and costs thirty-five cents extra.

Where large areas are to be treated, barrels of oil should be distributed at various convenient points, in or around the marsh.

The amount of oil to be applied is one fluid ounce to each fifteen square feet of water surface. A less quantity will often fail to kill the wrigglers.

SCREENING OF RAIN WATER RECEPTACLES.

Many shore cottages are not connected with the water supply of the villages or cities, but rain water is collected from their roofs and conducted into barrels or cisterns, from which it may be drawn as needed. Where these barrels or cisterns are above ground and uncovered, *Culex pipiens* will certainly breed in them. Such receptacles should always be screened, and if it is necessary to take water from the top of the barrel, mosquito netting tacked upon a hoop, somewhat larger than the top of the barrel, can be placed over it and removed at pleasure, and mosquitoes cannot reach the water to lay their eggs.

Tin cans, kettles, broken bottles, clogged gutters and other receptacles on the dump or scattered promiscuously, are prolific breeding places wherever they contain water for a week or more and should never be tolerated.

COMMUNITY EFFORT IN MOSQUITO CONTROL.

In any work directed toward the control of mosquitoes in the salt marsh region, little will be accomplished except through coöperation. If one marsh is drained, some relief will be felt by those residing near it and especially on the inland side of it. But in order to really do away with the mosquito nuisance, all salt marsh areas for a distance of several miles should be drained. In the absence of State legislation, this can be done only through community effort, as the separate property owners will not as a rule coöperate effectively to such an extent, and many of them will not expend a dollar for such improvement work on their own land. If money is raised by subscription and enough procured, then large areas, beginning with the worst ones, can be treated and relief obtained.

Lower prices for draining work will be obtained through coöperation than could possibly result if each owner arranged by himself for having it done.

LEGISLATION NEEDED.

Though much can be accomplished through the coöperation of adjacent communities in treating salt marshes for the purpose of controlling mosquitoes, in order to gain the greatest benefits to all concerned, some state-wide movement should be inaugurated. Authority to drain marshes whether the owner desires it or not, should be conferred upon some officer or commission, especially where it benefits the whole community, the town and the state, without injuring the property or working any hardship to its owner.

Just what arrangement would be best has not been determined, but if the State could bear a part of the expense—perhaps one-half, and give the work proper supervision and insist on its maintenance—and the remaining portion be met by the town and the owner, each paying a certain definite percentage, in just proportion to the benefits received, it would seem to be the most desirable solution of the problem.

The salt marshes are owned by a large number of freeholders, some of whom are non-residents. Most of the owners, if they can be found, are willing to have their lands drained, but

work which, if carried through, would be a great benefit to the whole community or town, including himself.

Legislation is therefore essential to provide for the systematic and wholesale draining of the salt marsh areas of the State.

SUMMARY.

The mosquito plague of Southern Connecticut is composed chiefly of two species of salt marsh mosquitoes—the brown salt marsh mosquito, *Culex cantator* Coq., and the banded salt marsh mosquito, *Culex sollicitans* Walk., which breed in the brackish stagnant pools of the salt marshes and fly inland several miles in search of their food, viz. the blood of the higher animals.

The rain barrel mosquito *Culex pipiens* Linn. breeds in rain water barrels, tin cans and other receptacles along the shore, and certain other species of *Culex*, as well as the malarial mosquito, *Anopheles*, may breed in the fresh water pools next to the highland, yet these are all local, fly only short distances and form only a small part of the mosquito plague of the coast region.

The salt marsh region of Connecticut contains 34.79 square miles, or 22,264 acres, more than half of which has in past years been drained for salt hay farming. During recent years the marshes have received little attention, the ditches have become filled and probably breed more mosquitoes than they did thirty or forty years ago.

The conditions are such as to check the proper and natural development of the Connecticut coast region as a site for summer homes; the land produces little, and is unprofitable, yet taxes are collected upon it.

Tide gates in proper working condition will keep tide water from flowing over the marsh but do not prevent the fresh water entering the marsh from the highland. This must escape to the ocean and draining is the only treatment to be advised. Narrow deep ditches are much more permanent than broad shallow ones. The lateral ditches should be not more than ten inches wide and from 24 to 30 inches deep, and placed from 100 to 150 feet apart, running parallel with each other, and nearly at right angles to the main stream or the broad central ditch.

The cost of draining the Connecticut marshes will vary, but may be done by contract at from $5.00 to $10.00 per acre, and

should not average more than $8.00. The entire salt marsh area of Connecticut can be drained for less than $200,000.00.

The increase in yield of salt marsh hay will soon pay the cost of draining and may do so in a single season.

Mosquito wrigglers may be killed by oiling the breeding pools, but this should be considered as only a temporary measure and should not be advocated in place of draining.

The methods of draining and oiling are shown on the plates, and described in detail on the pages of this report. Coöperation of individuals and communities are necessary for successful results in this work, and many towns and communities have taken it up. Legislation, however, is needed, and a State-wide movement with some State supervision would seem to be the best solution of the problem.

MOSQUITO CONTROL WORK IN CONNECTICUT IN 1912.

During the year there has been much interest shown in the subject of mosquito control, and a number of requests were made to this office for the examination of suspected breeding areas and for expert advice regarding treatment. Much has also been accomplished in draining marsh areas, and this paper describes briefly each area examined and also contains a summary of all draining operations to control the mosquito nuisance. For convenience each section or locality is discussed separately.

Greenwich.

In response to a request for an expert, Mr. Walden visited Greenwich on June 10th, and in company with Dr. E. O. Parker, chairman of Mosquito Committee, Board of Trade, and Mr. Edwin M. Skinner, president of the United States Drainage and Irrigation Company, examined the section within a radius of about one mile of the town hall.

Mr. Walden reports:

"1. At the foot of Nigger Hole Hill is a stream with a series of swampy areas along its course. There is considerable standing water in these places in which mosquito larvæ or wrigglers were breeding. The stream should be cleaned out and deepened so that it will drain all standing water.

2. Near Edgewood Inn is a small swamp with bogs and grass more or less covered with water. Mosquito larvæ were present in the water and many adult mosquitoes were found around the edges. In one direction the land is much lower than the swamp and a single ditch leading to this will give thorough drainage.

3. There is a low area at the right hand side of Prospect street with standing water all through the grass and weeds. This could be drained across the street to a brook on the left hand side which is much lower than the street.

The three above mentioned sections are ideal breeding places for the malarial mosquito (*Anopheles*), which will certainly be found there later in the season. The section near Prospect street is especially dangerous because there are many people living in the immediate vicinity.

Any one of the three places can breed enough malarial mosquitoes to infest the entire borough. Owing to the prevalence of malaria in Greenwich now the conditions will be much worse later in the season when the *Anopheles* become more abundant, if nothing is done to do away with their breeding places."

The Mosquito Committee conducted a campaign, issued literature, and obtained estimates for draining and filling sufficient to abolish the breeding places. The Board of Trade asked the borough officials for an appropriation for the work, but this was not granted, so no draining was done. Dr. Parker later reported a record of nine hundred authentic cases of malaria in Greenwich for 1912.

Stamford.

The drainage work here was done in 1911, and covered the entire coast line from the easterly shore of Bell Island to Shippan Point, a distance of about seven miles. Mr. W. L. Searles of Rowayton was chairman of the committee and was the leader in educating the people and arousing them to definite action. About $2,800.00, raised by voluntary contribution, was expended for draining 200 acres, and 125,000 lineal feet of ditches were cut. The residents are well satisfied with the work. This office had no part in this work, though in previous years the region has been examined twice and advice given.

Darien.

As in Stamford, the money was raised by voluntary contribution, and $3,800.00 was expended in draining an area amounting to approximately 300 acres of salt marsh and some inland swamps. The work was completed late in 1912.

South Norwalk.

In the work of South Norwalk and Darien, as well as in that of Stamford, Mr. Searles was the leading spirit. About 600 acres were here drained at a cost of $7,500.00, also raised by voluntary contribution, and the work was done in the summer of 1912. This office can share no credit for the campaign here or at Darien.

Fairfield.

The campaign in Fairfield was started by local initiative in November, 1911, and a committee arranged meetings and obtained contributions for the abatement of the mosquito nuisance. Six public-spirited citizens gave $1,000.00 each, and it was not a difficult matter to raise by voluntary contribution enough to make $8,400.00, which was the cost of draining 1,250 acres of salt marsh and some small inland areas. Before contracts were let, the Improvement Association of Fairfield and vicinity became incorporated and took charge of the work. Mr. Oliver G. Jennings was president and Dr. Valery Havard, secretary. No dues were required and a large membership was sought and about 300 joined the organization.

No oiling or other temporary measures were practiced at Fairfield, draining being the only means considered. The ditching was started in June and finished about August 1st.

The results are evidently satisfactory as Dr. Havard stated that the people were now able to use their porches with comfort afternoon and evening.

New Haven and Vicinity.

The Anti-Mosquito Committee, a sub-committee of the Committee on Sanitation of the Civic Federation of New Haven, instigated and, in coöperation with this office, planned a mosquito campaign. All other civic and health organizations were asked to coöperate and several meetings and conferences were held.

The officers of this committee were Dr. Louis M. Gompertz, chairman; Seymour C. Loomis, secretary; and Thomas W. Farnam, treasurer.

By means of illustrated and other lectures, newspaper articles and circulars the matter was agitated in early spring and the week beginning April 22d was set apart as "donation week" or "mosquito week" for raising funds. Through an effort organized and directed chiefly by the secretary named above a house-to-house canvass was made. Altogether nearly $5,000.00 was obtained by voluntary contributions in New Haven and vicinity, including adjacent portions of Orange and East Haven.

Fourteen lectures, treating of mosquitoes, were made by Messrs. Britton and Walden in or near New Haven. Five of these were illustrated with lantern slides, and most of the others were illustrated by specimens, photographs or charts. It is believed that much good resulted from the campaign aside from the money raised and the drainage and oiling work accomplished. An ordinance to prevent the breeding of house flies was passed by the board of aldermen, and a mosquito regulation adopted by the board of health. An appreciable advance was made in educating the people to recognize that these pests can be controlled.

Experts from this office examined the whole area several times in the season, both to locate breeding areas and to inspect the work of oiling and draining.

Before expending this money the Anti-Mosquito Committee was incorporated without capital stock, in order to put the work on a better business basis. Mr. P. L. Buttrick was employed as field agent, to have immediate charge of the oiling aud other field work.

Draining.

The principal breeding places were drained, beginning at Morris Cove and extending eastward to Silver Sands, and including several separate small areas in the West River meadows. The area drained is estimated at 347 acres, and cost $3,567.00. Bids were first obtained on draining a certain area at Morris Cove, situated partly in New Haven and partly in East Haven and extending up both sides of Morris Creek, from its mouth northward as far as the salt marsh reaches. Three drainage

contractors visited the area and submitted bids. The contract was awarded to the lowest bidder, The United States Drainage and Irrigation Co., 17 Battery Place, New York City. There must be a new tide-gate built on Morris Creek below South End road before the full benefit of the ditching will be realized. The property owners expected to build one, but have not done so. Included with the Morris Cove area, in the first contract was a small plot of twelve or fifteen acres in Fort Hale Park. This area was in bad condition and needed draining. The land is owned by the United States Government but is turned over to the City for use for park purposes. The work on this contract was completed early in July. The ditches were inspected by Mr. Walden on July 22d, and again on July 29th in company with Mr. E. M. Harvey of The United States Drainage and Irrigation Co.

Later this firm was employed to drain the South End marsh on a basis of a footage rate per lineal foot of ditch. On account of lack of funds, this marsh, especially at its eastern end, was not entirely drained, though most of the mosquito breeding was stopped in it. Nevertheless about 10,000 feet more of ditches are needed there to perfect the work, and should be cut as soon as funds are available.

Though the worst breeding places were drained first, it was thought best not to expend all of the money for permanent work in the same section. The West River meadows contained several small areas that needed treatment, and contracts were awarded to the same firm to drain two such areas; one west of the river between the New York, New Haven and Hartford Railroad tracks and Washington Avenue, and the other on the east side between Congress Avenue and the Derby Railroad. This work was done in August and was all examined August 21st, by the State Entomologist, in company with Mr. P. L. Buttrick, field agent of the Anti-Mosquito Committee and Mr. Edwin M. Skinner, president of the United States Drainage and Irrigation Co. Mr. Skinner recognized a few defects and promised to, and later did, send his men to remedy them. This drainage work, while on the whole satisfactory, must be extended over nearly all of the salt and some of the fresh marshes around New Haven, before the mosquito nuisance can be entirely eliminated. Draining, filling or dredging, i. e., permanent work

should be executed wherever possible, and other measures should be regarded as of doubtful expediency.

OILING.

The committee early planned to keep oiled through the season such breeding areas near the city as could not be drained. Though a simple matter in fresh water pools and receptacles it is a difficult one on large salt marshes. These areas are flooded at the perigee or very high tides, which though not as high in 1912 as in some seasons, came oftener and the meadows were flooded longer than usual, making it all along the Connecticut coast one of the worst mosquito seasons within the memory of the residents.

On much of the salt marsh area the grass is not cut for hay but water stands in it deep enough and long enough to produce mosquitoes. The presence of the grass interferes seriously with applying the oil to the surface of the water. Where the water occurs only in pools the matter is comparatively simple, but in late summer and early fall the very worst breeding places were in the grass, and many of these areas showed no signs of breeding in the spring and early summer.

At first the oiling was done with small knapsack compressed air sprayers. The "Auto-spray" shown on plate XIII made by the E. C. Brown Co., Rochester, N. Y., was first employed, being available, light and inexpensive. But this pump did not prove to be very durable and later one of the "Simplicity" pumps, made by the McCormick Manufacturing Co., of Dayton, O., was ordered.

No work was done on the Quinnipiac marsh, but all other marshes near the city not drained were oiled. As the grass breeding became more extensive and intensive toward the latter part of the summer more powerful pumps were needed, and a Hardie Wheel Outfit was procured. After a trial, the "Double-Forester," designed for fighting fires and made by W. & B. Douglas, Middletown, was purchased. Both of these pumps were quite effective, though requiring two men to each outfit. Each pump is sufficiently powerful to throw a heavy spray or solid stream for some distance, and it is unnecessary to walk over the entire area as is the case with the smaller outfit. But even larger outfits were given a trial. When the

breeding season was at its height Mr. Buttrick borrowed some barrel spray pumps, such as are used for spraying trees, and hired extra men to use them. By such means he was able to head off one brood of mosquitoes wbich was in danger of emerging before the territory could be covered by his regular force with the small pumps.

Altogether nearly $1,000.00 was expended in oiling. It is rather expensive, costing on the salt marsh about one-fourth to one-third as much in one season as to drain the same area. The drains, with slight attention, are effective for many years, but the oiling must be repeated with the subsidence of every bigh tide.

For part of the work kerosene was used, chiefly because it could be procured at a reasonable price at every corner grocery, often saving expense in the time of the men, if it had to be carried long distances from a central distributing point. But later in the season when more oil was used several barrels were purchased of a heavier oil, known as "light fuel oil" or "34° distillate," and a barrel placed near the center of each particular area where it would be used. This oil is somewhat less expensive than kerosene, and lasts longer upon the surface of tbe water. It is probably more destructive to vegetation, and to animal life in the water than kerosene—though both kill mosquito larvæ readily. The Park Commissioners oiled the breeding places within the public parks.

From the actual cost of doing the work, Mr. Buttrick computed that for the early brood the cost per acre might be as low as three cents. In midsummer the cost was about sixteen cents per acre per brood, while for the heavy broods of August and September the expense probably reached $1.00. The average per brood would probably be nearly fifty cents per acre. If there are seven broods in a season it will be seen that the cost of oiling alone may amount to $3.00 or more per acre, for a single season.

As most of this marsh land can be drained for less than ten dollars per acre, systematic oiling is hardly to be advised.

Future Work Around New Haven.

In order to be practically rid of the salt marsh mosquito nuisance, more draining must be done next year. This should

include the area on the east side of the harbor north of Fort Hale Park, portions of the Mill River meadows, Quinnipiac marsh, West River meadows, and at Sandy Point, Old Field Creek and Cove River marshes in Orange. Additional ditches should be cut at South End, and there are still other marshes in East Haven between Momauguin and the Branford line. The City of New Haven should also drain Beaver Swamp, where malarial mosquitoes breed abundantly, and all other breeding places within its park area.

Corporations Interested.

Several transportation and manufacturing corporations have shown sufficient interest in the subject to have their marsh land examined and estimates obtained for draining it. For the most part the estimates were submitted late in the season and action was deferred until the following spring.

Branford.

In 1911 some draining work was done north of Short Beach, and several years ago Mr. Wm. A. Bryan, at his own expense, drained many acres of salt marsh near Indian Neck. Dr. Chas. W. Gaylord has also at different times exercised his authority as health officer to drain areas where malarial mosquitoes were breeding. Several years ago the residents of Pine Orchard raised money and drained a small marsh and oiled other areas near that settlement.

Early in 1912, Dr. Wm. H. Carmalt, chairman of the House Committee of the Graduates Club, asked us to make an examination of the marshes in the vicinity of Double Beach, the hotel there having been rented by the Club. Mr. Walden, with the help of Mr. Kirk, examined this area. That portion west of Double Beach was examined on May 10th, and the remaining portion west, as far as Branford River, on May 20th. Had the examination been made in July, August or September, mosquito breeding would have been found far more extensive, as is the case in all salt marshes. Mr. Walden's notes refer to breeding places located on maps by means of numbers and are as follows:

Marshes west of Double Beach, examined May 10, 1912.

"603. At entrance of hotel grounds on both sides of drive, there is standing water in which wrigglers were breeding (fresh water species).

604. Holes blasted in the ledge, which hold water and in which fresh water wrigglers were found.

605. This whole marsh area is in bad shape. The old ditches are choked and the marsh is soggy, with much standing water, in which salt marsh wrigglers (probably *Culex cantator*) were abundant. It will be necessary to reditch this whole section to prevent breeding. The worst breeding is across the north end and down the east side, next to the road covered with crushed stone. Near the entrance to the private place there is breeding on both sides of the road.

606. Small, soggy areas which need draining. Wrigglers were present in all standing water.

607. Small marsh of two or three acres across the south side of which is a roadway with stone retaining wall next to water. Towards the west end was a sluiceway through which flows the stream that drains the marsh. This sluice has collapsed, choking the stream so that the marsh contains standing water, especially on the north and east sides. The water contained large numbers of wrigglers. The sluiceway should be repaired and small ditches should be dug from the edges of the marsh to the main stream.

608. In the whole upper half of this marsh and west of the stream down to the road where the trolley runs, mosquitoes are breeding abundantly."

Marshes east of Double Beach, examined May 20, 1912.

"609. Small marsh north of Double Beach Hotel; a few wrigglers were found. A single ditch from shore to west side of area will drain all standing water.

610. The west and north portions of this marsh have much standing water, and mosquitoes are breeding in it. Should be drained.

611. South edge of this small marsh next to high land has choked ditches with standing water and is breeding mosquitoes.

612. A low marsh flooded by tide when examined. No mosquito breeding found.

613-614. Water standing at these spots, containing wrigglers.

615-616. Standing water which may breed mosquitoes later in the season.

617. Sparse breeding along the edge of marsh.

618. Upper end of marsh, where the drainage has been cut off by a road crossing to a sand bank on west side.

619. This marsh is in very bad condition. The whole area is in need of ditching. The worst breeding spots in the sections are marked 619."

Estimates were procured on draining these marsh areas, but nothing else has been done. Possibly next season may bring some definite action.

In May, 1912, Mr. David Daggett of New Haven applied to this office for an expert examination of the region about Pine Orchard, to learn what measures should be adopted to eliminate the mosquito nuisance there. As we were all busy, at our suggestion, Mr. P. L. Buttrick was employed for this purpose by Mr. Daggett, who requested that the report be submitted to this office for approval before further action on it was taken.

The examination was made during the latter part of May and a report of six typewritten pages and a map was submitted for my approval May 29th. This report covers the coast from Branford River to Stony Creek and includes data on fresh as well as salt marshes. The suggestions for treatment have not been adopted as far as I can learn, so there still remains considerable work to be done in this section.

Guilford.

A citizen of Guilford is authority for the statement that the selectmen have caused to be drained certain sections of marsh land in that town. I do not know the area treated nor in what year the work was done.

Old Saybrook and Old Lyme.

My first knowledge of any attempt at mosquito control near the mouth of the Connecticut River resulted from the call at my office of Mr. Brooks on May 17. He stated that at Fenwick, where mosquitoes had been quite a nuisance, the residents had determined to use an abundance of oil, floating it in on the tide

as a relief measure. I advised him that draining was the proper means, and cautioned him against expending too much money upon oil.

Nothing more was heard from this section until October, when I received a letter from Mr. R. A. Rutherfurd of Black Hall, who had planned to procure estimates on draining the entire area, a portion of which lies in the town of Old Saybrook and the remainder in Old Lyme. Mr. Rutherfurd obtained estimates, saw the residents most interested and enlisted their support, then arranged for two meetings on November 1st, one at 4 P. M. in Old Saybrook and another at Old Lyme at 8 P. M. A representative of the United States Drainage and Irrigation Co., which made the estimate, was present, and the State Entomologist gave a brief talk at each meeting. Since that date a committee in Old Lyme has organized an Anti-Mosquito League and in all probability some draining will be accomplished next season.

Fresh Water Breeding Places.

On May 16th, at the request of Dr. Wm. H. Carmalt, I visited the property formerly known as Lion Park, now owned by the New Haven County Anti-Tuberculosis Society, on Campbell Avenue, West Haven, making an inspection of possible mosquito breeding places on the property. The following report was submitted to Dr. Carmalt:

"That portion fronting on Campbell Avenue, where several drains have recently been installed, is now in good condition. There is a little moisture above ground, due to the recent heavy rains, but I believe this will entirely disappear after a few days of pleasant weather. The only portion of the ground which needs any treatment is the brush-covered area near the southwest corner. There is more or less water standing in the depressions scattered over a part of this area, and the deeper pools, or nearly all of them, contain mosquito larvæ, some of which are nearly full grown. These are probably *Culex canadensis*, one of the species which breed in woodland pools early in the season. The brush here grows so thickly that it is difficult to get through it to make a careful examination of this part of the grounds. Kerosene should be put on these pools at once in order to kill the larvæ now in them. The oil can be

applied easily on these small pools with an ordinary sprinkling can, though it is necessary first to cut some of the brush in order to get at them.

I believe that the best treatment for this area is to cut a ditch perhaps eighteen or twenty inches deep and a foot wide, running through the center of the swampy area in a westerly direction or perhaps a little north of west, following the natural drainage line to the swamp near the railroad back of your property. Perhaps it will be necessary to cut a few short lateral ditches leading into the larger breeding pools, using the material removed from the ditches to fill in the small depressions. This work, of course, can be done under the direction of any engineer or contractor, and presents no particular difficulties.

I presume there is more territory west of your property which also needs draining, though I did not look over the adjoining field."

On June 20th, 1912, at the request of Dr. W. S. Lay, health officer of Hamden, I accompanied him in his automobile, from the corner of Whitney and Putnam Avenues, to look at some stagnant pools which he regarded as unsanitary.

First we went through Putnam Avenue, to where a small sluggish stream crosses upper Newhall Street. This stream comes from the vicinity of Prospect Street, near the base of Mill Rock, and crossing Newhall Street, enters the swamp owned by the New Haven Water Company. A high wire fence prevented us from examining the water on this property, but where it crossed the street, as well as above it, was in a filthy condition. Though the water was tested at a few places for wrigglers, none were found. Dr. Lay pointed out a number of houses nearby where undoubted cases of malaria occurred last year and this spring. This seemed to be the source of the malarial mosquito. From the condition of the stream and swamp it must surely breed malarial and other mosquitoes later in the season, and should be regarded as dangerous, at least in its present condition. The Water Company should cut, on its own property, a deep central ditch, sufficiently broad to carry off the water, with a few laterals to drain the margins of the swamp. The material excavated should be used for filling depressions between the ditches. Above Newhall Street, the bed of the

stream should be cleared and straightened, some of the brush cut and the water stocked with minnows. Several coves in the margin of the upper part of Lake Whitney receive surface water from the surrounding territory and are separated from the main part of the lake by sand bars which are supposed to act as filters. These cut off parts of the lake, must certainly be mosquito breeding areas at times and should be given attention. The margins are shallow and more or less grown up with vegetation. Even if stocked with fish there would probably be mosquito breeding around the edges.

We then went north and west, where, between Dixwell and Circular avenues, and south of Cherry Hill we found a large stagnant pool, of perhaps eight or ten acres in extent. Apparently this pool has no outlet, but the water is shallow and grass grows through it over most of the surface. We did not test this pool for mosquito breeding. At Mt. Carmel post office we turned to the east and then to the north, into the road running parallel with the trolley tracks. At a point directly back of Mr. Woodruff's, opposite the vicinity of the Station farm, there are at least three sink holes, each containing a foot or more of water, all more or less grown up with brush, the present species being button bush, and half of the bushes were dead. Various aquatic plants grow around the margins, the latter so covered with brown scum that it was difficult to examine the water. Adult mosquitoes, resembling *Culex pipiens*, fairly swarmed here. We did not succeed in finding larvæ, and on account of the soft mud around the edges and the lack of rubber boots, it was impossible to make tests except in a few places. These places were formerly drained into the stream which is only a short distance eastward, but the ditches need to be deepened and the brush should be cut to let in the sunlight and to facilitate the work of draining and oiling. These places are on land either owned or controlled by the New Haven Water Company, and should receive attention at once, as the residents of the vicinity have already entered a complaint.

Returning to the trolley line at Mt. Carmel center, the commencement of the old canal and at the south end, near the railroad station we found one malarial wriggler in the water.

Advised Dr. Lay to work for the permanent draining of this canal, and to fill portions of it, if not possible to drain it entirely.

Organized Effort Toward Legislation.

Knowing the interest in the subject of mosquito suppression, and its importance to the people of the State, the Station called a meeting for September 17th, and invited all men to attend who were known to be interested in the object of the meeting. Nearly one hundred invitations were issued, but less than twenty were present. Many letters were received from others expressing their regret that on account of previous engagements they were unable to be present. Dr. Gaylord of Branford was chosen chairman. The situation in all its phases was discussed, and the speakers were unanimous in declaring legislation necessary. Consequently it was moved that the chairman appoint a committee of five to further consider the matter and, if it saw fit, to draft bills to be introduced into the next legislature, the committee to report at another meeting to be called prior to January 1st, 1913.

The committee, of which Dr. Chas. J. Bartlett of New Haven was chairman, met twice and decided upon two measures, one providing for the drainage of the larger marsh areas, and the other giving more authority to the health officers to remedy local mosquito troubles. These bills were submitted to the people attending the second meeting at the Station, November 22. Through a suggestion made at this meeting, a portion of the second bill was omitted and the matter covered by an amendment to Section 2526 of the General Statutes (Revision of 1902). The meeting then voted approval of these three measures and the chairman was empowered to appoint a committee to acquaint the people with these proposed laws and to support the bills at the legislative hearings. Dr. Wm. H. Carmalt of New Haven was appointed chairman of this committee.

The following table shows the approximate number of acres of marsh land which have been drained recently, and all but the Stamford work was done in 1912. Moreover, the cost, which is also shown in the table, was borne by voluntary contributions:

Mosquito Drainage Work in Connecticut.

Location.	Approximate *Acreage.*	*Cost.*
Stamford	200	$2,800.00
Darien	300	3,800.00
South Norwalk	600	7,500.00
Fairfield	1,250	8,400.00
New Haven	347	3,567.00
Total	2,697	$26,067.00

OUTBREAK OF THE FALL ARMY WORM.

Laphygma frugiperda S. & A.

On September 3d a few specimens of the larvæ were received from Mr. Fred Hoadley of Stonington, where they were devouring the grass of a lawn in the village. The caterpillars were collected on August 31st, and Mr. Hoadley reported that they seemed to eat grass only, and had destroyed the lawn. Mr. Hoadley had sprayed the remaining grass with lead arsenate, which killed the larvæ.

On September 10th a large number of larvæ and pupæ were brought to my office from the lawn of Mr. Thomas Hooker, 51 Hillhouse Avenue, New Haven, where they were rapidly devouring the grass. Many of the larvæ had Tachinid eggs fastened upon their heads and bodies, showing that they were strongly parasitized.

The next day, September 11, in response to a request, I visited Branford House, the residence of Mr. Morton F. Plant at Groton, to examine the work of this insect. Several acres of lawn had been entirely devastated and the ground was being disked preparatory to reseeding. Many of the caterpillars here had pupated though some were still small, and apparently about half grown. Here also were many Tachinid eggs indicating that parasites were present.

On September 11th another box of specimens was brought to the Station by Mr. William Roberts, from the field of his neighbor, Mrs. Upson. In this case the larvæ were devouring millet and doing considerable damage. These also showed evidences of parasitism and there were pupæ in the box.

On September 22d adults emerged from the material collected at Groton and also from New Haven material. Adults continued to emerge until October 9th.

Dr. Felt* reports that this insect was very abundant in the vicinity of New York and on Long Island the latter part of September and the first part of October. It attacked lawns chiefly, but injured corn on Long Island.

From a circular issued August 31st, by the Secretary of Agriculture, it appears that this insect has this season caused

* Journal of Economic Entomology, Vol. 5, p. 403, October, 1912.

great destruction of crops in the Gulf States and northward, attacking nearly all kinds of vegetation, but especially grass, corn, alfalfa, cow peas, cotton, sugar cane and rice. The fall army worm was not the only offender in this southern invasion but was accompanied by the true army worm *Heliophila unipuncta,* Haw., and by the cotton worm *Alabama argillacea,* Hübn. In Connecticut, however, these two last named species were not seen in the adult stage, though the army worm is probably present in small numbers and several adults have been taken at light each season.

Description and Life History.

The adult of the fall army worm is a moth belonging to the family Noctuidæ, and has a wing expanse varying from one and one-fourth to one and one-half inches. The primaries are narrow and in the male are often without prominent markings, being uniformly mouse grey. The female has conspicuously mottled primaries, which can be seen better than described if the reader will examine plate XIV, a, of this report, where both sexes are shown. The secondaries in both sexes are nearly white, semi-transparent and iridescent, with a dark border, which is broadest at the apex, and gradually diminishing and disappearing altogether before it reaches the inner angle.

Body mouse grey, somewhat lighter than the primaries. The females lay pearly-white ribbed eggs in clusters of 50 to 60 and covered with mouse-colored hairs from the abdomen of the parent. These eggs are laid on the leaves and stems of grasses and when abundant the females often deposit eggs on the leaves or twigs of trees, walls, fences and buildings. The eggs hatch in about ten days and the young begin to feed upon their favorite food plant, which is usually grass of various kinds, with the cereals as second choice, followed by the other crops mentioned. There are probably two generations in this climate and the larval period is not well known here. It probably varies greatly in different seasons. Our collection contains several adults collected in Maine between August 10th and September 7th. The late appearing female moths lay eggs, but from studies made at Washington, D. C., a few years ago, it appears that though these eggs hatch and the larvæ feed until cold weather, then go into the soil, that they are not able to

survive the winter. In most cases the adults do not emerge in the fall, but pass the winter as pupæ and appear the following May. As we have a good supply of material we hope to be able to make further observations on the life history of this insect.

The full grown larva varies from one to one and one-half inches in length and somewhat resembles the common army worm but is darker in color. The Stonington specimens were described as follows:

Length 28 mm. (1⅛ inch): thickness 3 mm. Color dark purplish grey or black dorsally, greenish or light brown ventrally. A spiracular lateral stripe extends longitudinally, with yellowish ground-work faintly marked with light brown. There are narrow, broken, subdorsal lines of cream color, with faint parallel tracings between them. The first segment has a well-defined, cream-colored dorsal line which disappears entirely on the second or third segments. Anal segment with cream-colored dot. Head black, shining, with an inverted Y-shaped, cream-colored, facial mark. Antennæ white with black tips. Legs brown. Each abdominal segment shows dorsally six black tubercles, the front pair being nearer together than the rear ones, the lateral pair being distad of the front and caudad of the rear pair. There are two rows of black tubercles below the yellow spiracular stripe. Each tubercle bears a short black and rather stiff hair.

The pupa is about five-eighths of an inch long, brown and much resembles the corresponding stage of other Noctuid moths. Larvæ, pupæ and adults are shown on plate XIV.

Natural Enemies.

I have already mentioned that the larvæ were parasitized. Three female Tachinid flies emerged October 5th, from the Groton material. These were identified by Mr. Harrison E. Smith of the Bureau of Entomology, as *Winthemia quadripustulata* Fabr., a species common on this as well as on other hosts. Chittenden* mentions another fly, *Frontina frenchii* Will., of the same family reared from material collected at Columbia, S. C. He also mentions the Hymenopterous parasites, *Apanteles*

* Bureau of Entomology, Bull. 29, p. 36, 1901.

laphygmae Ashm., MSS., *Limneria dubitata* Cress., and *Euplectrus comstockii* How., as having been bred from the larvæ. Several specimens of wasps are known to attack the larvæ in the Southern States and the larva of a ground beetle, thought to be the fiery ground beetle, *Calosoma calidum* Fabr., is known to prey upon them. This beetle is common in Connecticut.

Control Measures.

Lawns may be sprayed or drenched with an arsenical poison, preferably lead arsenate, to kill the larvæ which feed upon it. This was used by Mr. Hoadley with good results at Stonington, and would be particularly effective in the early stages of the damage before the larvæ are fully grown. It usually happens, however, that the larvæ remain unnoticed until they have made their work conspicuous, and by that time many have transformed to pupæ. It is then too late to poison them. Applications of kerosene emulsion, followed with copious drenchings from the hose, is said to be effective.

There are several mechanical measures that may be employed. One of these is to roll the ground in early morning or in late afternoon when the larvæ are feeding, going over the land several times with a heavy roller.

At Groton a disk harrow was employed to cut up the turf, to make a suitable bed for reseeding the lawn. Possibly this treatment was unnecessary. Even though the grass was wholly devoured above ground it would come up again and be green if the crowns of the plants or the rootstocks were not destroyed. Nevertheless, the harrow was in operation when I visited the place and I advised that it be driven over the lawn many times in different directions to kill as many as possible of the larvæ and pupæ.

As most of the insects winter as pupæ in the soil, late fall plowing may be regarded as an important control measure, especially on land where the field crops have been attacked and injured. It is not advisable for lawns. If large flocks of chickens or turkeys can be placed upon an infested field, no doubt many of the larvæ and pupæ will be devoured.

Attention should be given this insect next year, as the fall army worm sometimes causes considerable damage earlier in the season.

SERIOUS INJURY BY WHITE GRUBS.

In the report of this Station for 1909, page 372, there was published a short account of injury to grass lands that season by white grubs. Judging from observations, correspondence and other reports, this injury in 1912 far exceeded that of 1909, and not only was grass damaged but various cultivated crops such as strawberries, corn and even potatoes were badly injured.

Specimens of the grubs were received July 23d, from Botsford; August 22d, Bethel; August 23d, Noroton Heights; August 28th, Darien and Saugatuck; September 12th, Noroton; September 28th, Meriden; and October 15th, Fairfield. Inquiries were also received and answered from Colchester, Norwalk, Wallingford, Prospect, Cheshire, Watertown, Plantsville, Southport, Southbury, New York City and Hammonton, N. J. At Prospect, Cheshire, Noroton, Darien, Southport, Fairfield, Southbury, Meriden and New York City the grubs caused injury to grass in meadows and in one case on lawns. Injury to corn was the reason for inquiries from Botsford, Colchester, Norwalk, Wallingford and Cheshire. Mr. Filley reported a case in Southington where two acres of corn had been killed by the grubs. The inquiries from Bethel and Watertown reported strawberries as being the crop chiefly damaged, and serious injury to potatoes was the complaint from Noroton Heights, Darien, Saugatuck and Plantsville. Mr. Moss reports very serious injury to potatoes in West Cheshire. In one case a row five rods long furnished at harvest only thirteen good potatoes. On the land of the Northeastern Forestry Company at Cheshire, where several acres were devoted to potatoes, only about 25 per cent. of the crop escaped injury. Here, also, there was great damage to forest tree seedlings. White pine is the kind of tree grown there most extensively and it was the most injured, nearly 25 per cent. of the seedlings being damaged. Some of the seedlings lost their roots entirely, as shown on plate XV, a, while others were partly eaten off. Black locust and other kinds of hard wood seedlings were also attacked and injured, though to a less extent. The inquiry from Hammonton, N. J., stated that the grubs were destroying lettuce plants by eating the roots in the beds, where they were evidently intro-

duced in the compost, which is usually made of turf and stable manure. Professor Forbes found thirty-four grubs in a single hill of corn in an Illinois field.

The dry season seems to favor the increase and abundance of white grubs. Several such droughts in succession generally precede or at least accompany severe white grub injury. Normally, grubs are present in the soil and feed upon grass roots, but it is only when abundant that they cause conspicuous damage. Plate XV shows the adult beetle, larva and the injury caused by this insect.

Life History.

White grubs are the larvæ of May or June beetles, belonging to the genus *Lachnosterna* and to the family Scarabæidæ. There are many species in the United States, and our collection contains fourteen species taken in Connecticut. Probably several others occur here. Of this number *L. fusca* Frœh., *L. crenulata* Först., *L. hirticula* Knoch., *L. nova* Smith, and *L. fraterna* Harris, are the common ones and one or more of these are doubtless responsible for the damage to grass and hoed crops. Most of our material was examined by Mr. John J. Davis of Lafayette, Ind., who is working on this genus for the Bureau of Entomology. Though the exact life history has not been carefully worked out for each species, it is supposed that three years are required for the insect to pass through the entire period of development from the egg to the adult beetle. Most of this time is occupied by the larval period and passed in the soil. It is the last year as grubs when they are large and voracious that the larvæ do most of their feeding and consequently most of the injury. The work of the smaller and younger grubs of a later generation is probably seldom noticed, though usually occurring in the same field with the larger ones.

The eggs are laid in the month of June in grass land or cultivated fields, and are white, oval, and about one-tenth of an inch in length. Each egg is laid in a ball of earth perhaps a half inch in diameter and placed in the ground from one to five inches beneath the surface. In about two weeks the eggs hatch and the young grubs begin to feed upon the roots, growing slowly at first. At the end of the first and perhaps the second seasons the grubs go downward from seven to fourteen inches

below the surface to pass the winter. At the end of the last season the grub makes an earthen cell in the ground, and after three weeks there, changes to a soft, light brown beetle. It remains in the ground, however, until the following spring, when in May or June it emerges a dark, brown beetle with hardened wing covers. The adult beetles feed at night on the leaves of various trees, sometimes defoliating them. It is probable that the various species may have different feeding habits and food preferences, but these are not well known and must here be treated as if the same. The beetles hide through the day in the soil and may often be turned up with the rake or the spade in the garden. In early evening late in May and during the first part of June the beetles make much noise in their clumsy flight and certain species are attracted by lights and may be found in large numbers under arc lights.

Control Methods.

Like several other noxious insects, white grubs should be controlled by cultural practices rather than by the use of applications. Corn, strawberries and other crops commonly damaged by white grubs should not be planted on sod land as it is usually on such ground that the greatest damage occurs. Rotation of crops is apt to prevent this multiplication and it is where land is kept in grass for several years at a time that it is most seriously injured. If hogs can be turned upon infested land they will root it over and devour the grubs. Skunks have a similar habit, and I saw years ago in New Hampshire acres of grass so eaten at the roots that the turf could be rolled up like a carpet and the field filled with holes where the skunks had been digging after the grubs.

Fall plowing is to be recommended as it brings the larvæ and pupæ to the surface, where they are killed by freezing. If flocks of turkeys or chickens follow the plow they will eat many of the insects as will also blackbirds and crows.

Often the injury is noticed in midsummer, when it is advisable to plow the land and sow it to Hungarian or millet, thus getting another crop from it the same year. If the injury appears too late in the season for this practice, the land may still be sown to rye. In any case, whether the ground is plowed

in late fall or in spring, midsummer or early fall, it should be pulverized very thoroughly by going over it several times in different directions with a disk harrow to kill the larvæ or beetles. It is questionable if any application of chemicals, as is often advised, is worth considering. Common salt, lime, kainit and muriate of potash are sometimes recommended to kill white grubs, but the cultural practices mentioned are preferable; though any good fertilizer has a value other than for killing grubs.

MISCELLANEOUS INSECT NOTES.

A Gall-making Beetle of the Hop Hornbeam.—In April 1911, Mr. A. B. Champlain, then an assistant in this department, while visiting at Lyme, collected some branches of hop hornbeam or ironwood, *Ostrya virginica*, containing swellings or galls. On cutting open the galls, some were empty, while others contained borers, and a spiral gallery was visible. The branches were placed in breeding jars with the ends in moistened sand to prevent too rapid drying. In due time, on May 29th, three adult beetles were obtained. They belong to the family Buprestidae and to the genus *Agrilus*. They were sent for identification to Mr. C. A. Frost, South Framingham, Mass., who pronounced it a new species, and who was requested to describe it. Mr. Frost has named this species *champlaini*, in honor of the discoverer, and the description was published in the *Canadian Entomologist*, Vol. XLIV, page 245, August, 1912. The appearance of the gall is shown on plate XVI, c. Other specimens have since been reared by Mr. Kirk.

The Spruce Bud Moth, *Tortrix fumiferana* Clem.—This insect seemed to be unusually abundant in 1912. Several adults were taken at light on July 17th. On July 22d several adult moths were received from Dr. E. H. Jenkins, collected at his summer home, Pemaquid Point, Me., where he says that the larvæ defoliate and ultimately kill the spruce trees. The adults were mating at the time he collected them and the air was filled with them flying about. In a trip through eastern Massachusetts and along the coast in New Hampshire and into Maine during July, the writer also saw hundreds of these moths. In Connecticut, however, I have never seen them as abundant as they

were the past season. Occasional spruce twigs which may have been damaged by this species have been sent to this office. Two were received from New Haven and one from Stamford in 1911, but we were not able to rear the adult. An illustrated account of the destructive work of this insect may be found in the Fifth Report of the United States Entomological Commission, page 830, 1890, and a compiled account is given by Dr. Felt in his "Insects Affecting Park and Woodland Trees," page 416, 1906.

The moth has a wing-spread of an inch or slightly less, and the wings are finely mottled with light and dark brown. The winter is passed in the partly grown caterpillar stage among the terminal shoots of the branches, and in the spring the larvæ feed upon the leaves of the present and previous seasons' growth, making a web upon the terminal shoots and reaching maturity the last week in June. They then pupate in the loose leaves of their improvised nests, and in a week the adults appear. The eggs are laid in midsummer and hatch in ten days. There is but one brood each year.

Where choice ornamental and shade trees are attacked, they should be sprayed thoroughly with lead arsenate, using at least five pounds of paste or two and one-half pounds of dry powder in fifty gallons of water.

A Chrysomelid Beetle on English Ivy Imported from Europe.—While inspecting imported nursery stock in the spring, Messrs. Caffrey and Kirk found in one box containing several plants of the common English ivy, *Hedera helix*, some blue leaf-eating beetles which appeared to be feeding upon the ivy. The shipment came from Holland. All specimens found were collected, about fourteen in number. Through the kindness of the Bureau of Entomology, these were identified by Mr. E. A. Schwarz as *Agelastica* (*Galeruca*) *alni* Linn. Mr. Schwarz writes that the introduction of this beetle into the United States would be most undesirable. Though perhaps it is not regarded as an important pest abroad, it is included in Eckstein's "Forstliche Zoologie," page 442, 1897, and in Judeich-Nitsche's "Forstinsektenkunde," page 607, 1895, as skeletonizing the leaves of various species of alder. Whether or not it will attack and injure other kinds of foliage we do not know.

Southern Cabbage Butterfly in Connecticut.—Mr. Walden captured an adult Southern cabbage butterfly *Pontia* (*Pieris*) *protodice* Boisdv., at Yalesville, September 26th, 1912, while inspecting nursery stock. This is the first Connecticut specimen taken by any member of the staff of this department, though our collection contains a male and a female collected by Mr. H. S. Woolley of Waterbury and the species has been reported from several other localities in the State. Smith, in his list of New Jersey Insects, states that the Southern cabbage butterfly is common in some seasons in Southern New Jersey, though rarely found in the northern part of the State. Messrs. Walden and Caffrey observed wings of this species in a spider's nest and several adults were flying about at Yalesville. No doubt this butterfly is more common than we suppose and is usually mistaken for the much more common imported cabbage butterfly, *Pontia* (*Pieris*) *rapæ* Linn. *P. protodice* is the cabbage butterfly of the Southern States and the caterpillars feed upon the leaves of cabbage, cauliflower and other cruciferous plants.

Tolype velleda Stoll., Unusually Common.—This curious moth is closely allied to the tent caterpillar and belongs to the family Lasiocampidæ, some members of which are called "lappet" or "lackey" moths in Europe. At two or three different times during the course of our gypsy moth work, the men have found the caterpillars, at first thinking they were gypsy caterpillars, then noticing the difference. The caterpillars are very short and broad and are closely appressed to the bark, dull rusty or dark grey in color. The first specimen received at this office on July 27th, 1912, was a full grown larva from Centerhill, in the town of Hartland. On October 5th Mr. Stoddard of the botanical department brought in an adult collected in New Haven, and early in October the writer observed several of the moths resting on electric light poles about the city. On October 11th a box containing eight adults and three cocoons were received from Leonard Bridge in the town of Lebanon. The moths are grey and have a wing-spread varying from one and one-half inches in the male to two and one-fourth in the female. The primaries are crossed by white, undulating lines. The bodies have a woolly appearance, and are grey with a brown central stripe extending the length of the

thorax. The caterpillars fed upon apple, pear, cherry, maple, oak, willow, poplar and lilac, and will probably never be sufficiently common to be regarded as a pest.

The Elm Saw-fly.—This insect was rather abundant in 1912 and larvæ were observed in several places. On July 31st, a larva was received from Winsted, and on September 19th, three larvæ on willow were handed to the writer at Norfolk. The full grown larva is over an inch and a half long, head and body uniformly a light cream color with black spiracular dots and a narrow black or dark brown median dorsal stripe. (See plate IX, c.) The larvæ may be seen in the latter part of summer crawling down the trunks of elm, willow, poplar and linden trees, upon which they feed, seeking the ground to transform. Spraying the foliage with lead arsenate is the proper remedial treatment. If disturbed they curl themselves up like a snail shell. The adult is one of our largest saw-flies, also called "willow" or "giant" saw-fly and bears the name of *Cimbex americana* Leach.

Aphis on Potatoes.—On July 18th leaves of corn and potatoes were received from Mr. Noyes Palmer of Stonington, and from Mr. Alfred L. Beebe of Mystic, all infested with aphids which we took to be the potato aphid *Macrosiphum* (*Nectarophora*) *solanifolii* Ashm. This identification was later verified by Mr. Arthur I. Bourne of the Agricultural Experiment Station, Amherst, Mass. In 1903 this aphid was very abundant on leaves and stems of potatoes in Fairfield, and in July, 1909, Mr. Bourne, then an assistant in this department, found it on potatoes in the Station garden. In 1904 and the two succeeding years it caused serious damage in the large potato fields of Aroostook County, Maine, and Bulletin 147 of the Maine Experiment Station, by Dr. Edith M. Patch, is devoted to this species. Where plants are badly infested in small areas we may employ a spray of kerosene emulsion, but this did not seem practicable on large areas in Maine.

Tulip Tree Scale, *Toumeyella liriodendri* Gmel.—This is our largest scale insect. It is now attracting considerable attention and specimens were received during the season from Columbia, Fairfield, Greenwich, New Haven and Waterford. The female

scales are hemispherical, nearly one-third of an inch in diameter and brown in color. They are usually found upon and sometime kill the lower branches of tulip trees, afterward going to the higher branches. Small trees are often wholly infested. The males are much smaller and thinner. There is one brood annually, the young being born about September 1st. The proper treatment is to spray with kerosene emulsion during the latter part of September to kill the young. The old shells remain for a long time upon the twigs. Formerly this insect was placed in the genus *Lecanium*, and later was known as *Eulecanium tulipiferæ* Cook.

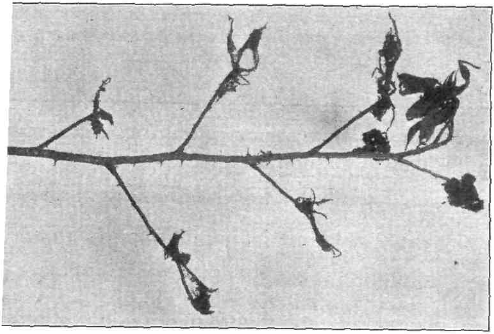
Juniper Web Worm, *Phalonia rutilana* Hubn.—On May 21st red cedar twigs were received from Wilton, containing a number of small webs. Though adults were not reared, the webs were probably formed by the Juniper web worm, which is described and illustrated by Packard in the Fifth Report, United States Entomological Commission, page 910, 1890. On November 4th, 1909, similar webs on dwarf juniper were sent to us from Greenwich. If choice or ornamental trees or shrubs are endangered a spray of lead arsenate will doubtless prevent further devastation.

The Garden Millipede or "Thousand Legs," *Julus hortensis* Wood.—On May 13th I was called to examine strawberry plants in a large field near New Haven. There were many dead plants, some no doubt having been injured the previous winter. The plants showed considerable tunneling in the main stems, probably the work of the strawberry crown borer *Tyloderma fragariæ* Riley, though only a few of the larvæ were present at the time of the examination. Many of the cavities, however, were literally filled with these millipedes (shown on Plate XVI, a, and b), apparently eating into the roots and crowns. In fact many of the cavities may have been eaten by them as they were very abundant on the field. At various times these millipedes have been sent to the Station, and reported as causing injury to plants. In Guilford in 1907 they damaged roots and bulbs in flower beds; in New Haven French anemones were injured by them in 1909, and beans in 1911.

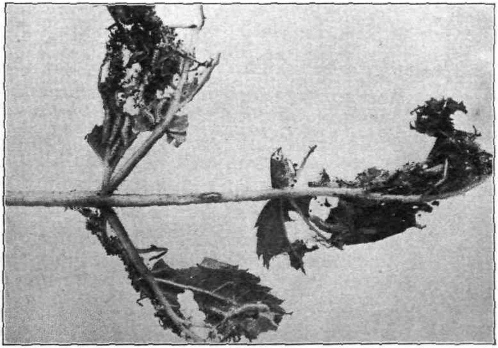
The remedies consist of poisoned baits, such as slices of potato, turnip or some other succulent root, dipped in a mixture of lead arsenate, white arsenate or Paris green, about an ounce of dry powder or twice as much lead arsenate paste to two gallons of water. The bait should be distributed over the infested portions of the field.

Mites on Ash Tree.—On August 27th I was called to examine a white ash tree on Huntington Street, New Haven, opposite the Station grounds. The tree was perhaps six inches in trunk diameter, and it was literally covered, not only on leaves and stems, but on the bark of branches and trunk, with a silk-like web upon which were crawling myriads of mites resembling the common red spider of greenhouses. This web was so thick on the bark that it glistened in the sunlight as if covered with ice, though somewhat iridescent. The mites were fairly swarming down the trunk, evidently migrating to another tree, or perhaps to lay their eggs elsewhere. The leaves, which were badly injured, were turning yellow and dropping, the drought probably increasing or aggravating the trouble. Slides of these mites were sent to Mr. Nathan Banks, of the Bureau of Entomology at Washington, who identified the species as *Tetranychus bimaculatus* Harv.

Mites on Chrysanthemum Flowers.—On November 14th, Mr. Kirk, when inspecting imported nursery stock at a florist's in Bridgeport was asked to examine some chrysanthemums which drooped and the petals withered and died. In a large flower, though freshly cut, dead and brown petals scattered through the blossom at once indicated that something was wrong. Though examined by both botanists and entomologists, the only parasites found were very small mites at the base of the petals. The mites seemed to be the cause of the trouble and were determined by Mr. Banks as *Tarsonemus pallidus* Banks.

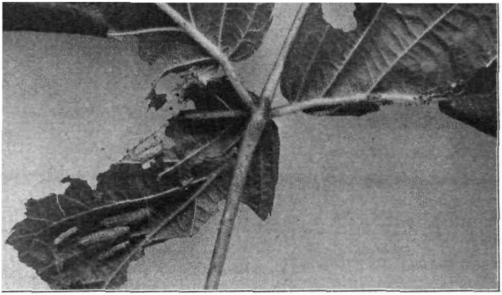


a. Blackberry cane nearly defoliated.

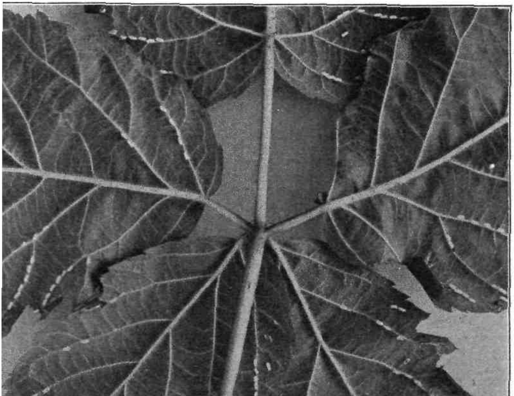


b. Larvæ on leaf. Natural size.

WORK OF BLACKBERRY SAWFLY.

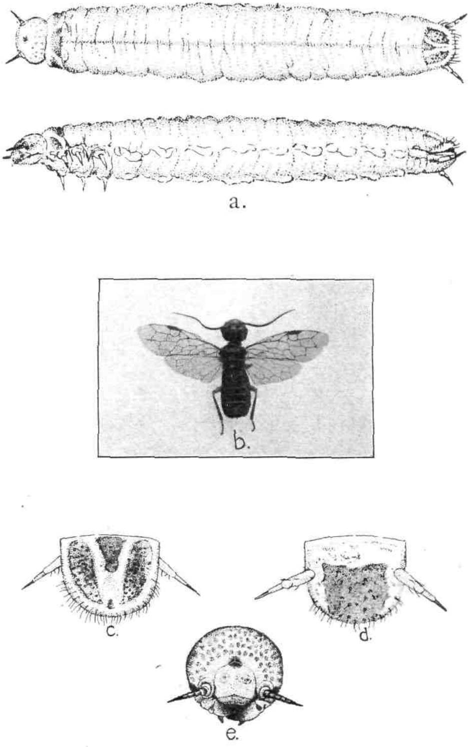


a. Leaf rolled by larvæ. Natural size.

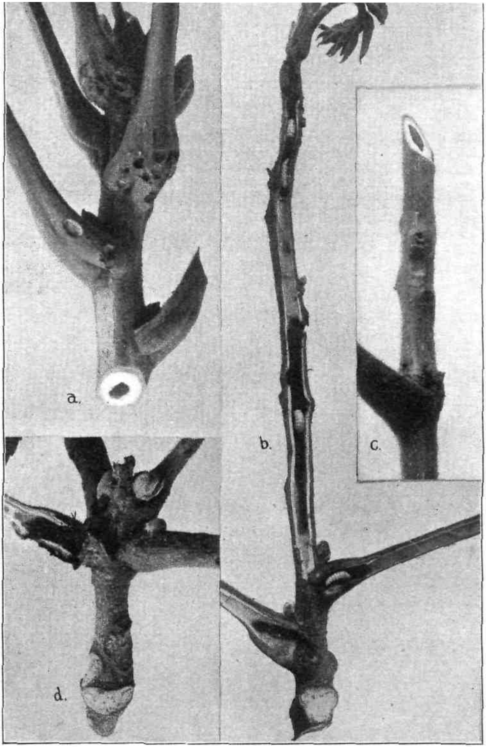


b. Eggs on under side of leaf. Natural size.

EGGS AND LARVÆ OF BLACKBERRY SAWFLY.



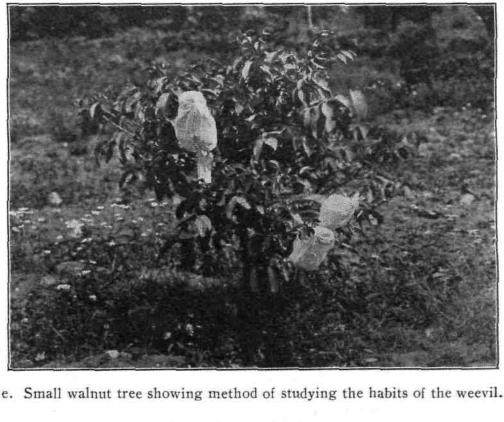
a. Larvæ, about five times enlarged. b. Adult, twice natural size. c. Dorsal view of last segment of larva. d. Ventral view of same. e. Face of larva—last three ten times enlarged.



a. Feeding punctures at base of leaf petioles. b. Larvæ tunneling in new shoot. c. Shows where frass is ejected through egg punctures. d. *Hickory probably attacked by this insect. All natural size.*

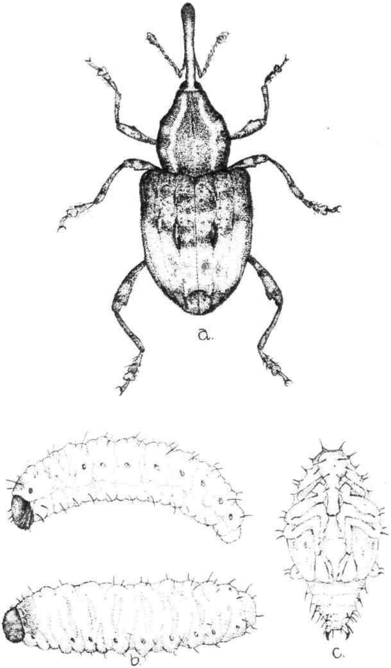
WORK OF WALNUT WEEVIL.

a. Appearance of infested butternut. b. Shows where grub had entered at end of butternut. c. Walnut showing egg puncture at tip. d. Grub inside of butternut. All natural size.



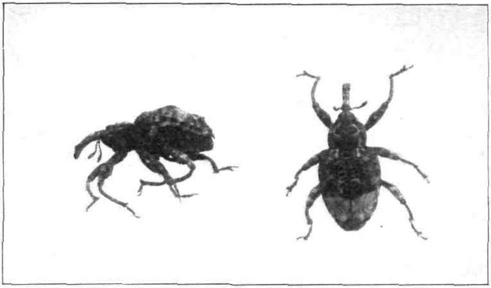
e. Small walnut tree showing method of studying the habits of the weevil.

WORK OF WALNUT WEEVIL.

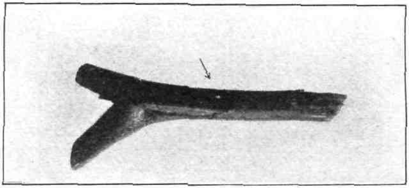


a. Adult. b. Larvæ. c. Pupa. All greatly enlarged.

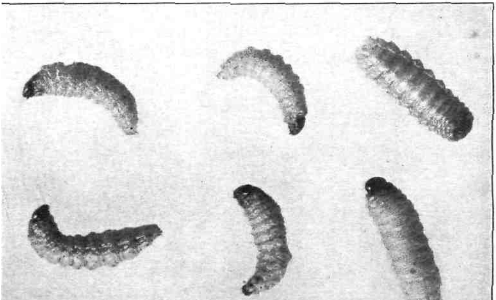
ADULT, LARVÆ AND PUPA OF THE WALNUT WEEVIL.



a. Walnut weevils. Four times natural size.

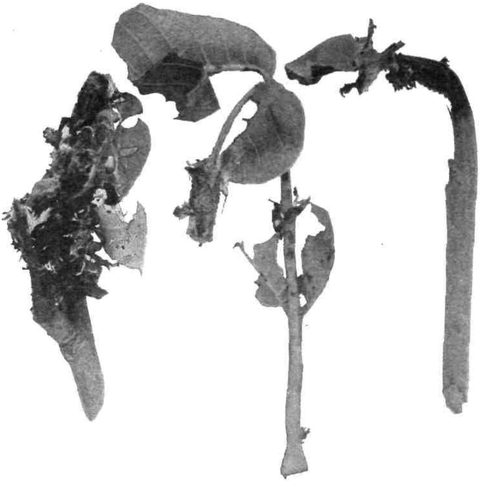


b. Egg as laid in stem. Natural size.



c. Larvæ. About two and one-half times natural size.

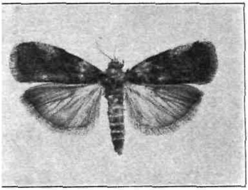
EGG, LARVÆ AND ADULTS OF WALNUT WEEVIL.



a. Nests at tips of new growth. Natural size.

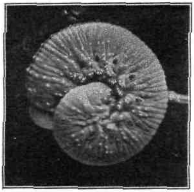
b. Appearance of infested shoots, natural size.

WALNUT BUD MOTH.



. Walnut Bud Moth, twice natural size.

b. Arrow shows egg of Bud Mot
Enlarged two and one-half time



c. Larva of Elm Sawfly.
About twice natural size.

d. *Oiling mosquito breeding pools with the "Double Forester" pump.*

WALNUT BUD MOTH, ELM SAWFLY AND METHOD OF OILING MARSHES.

a. Mosquito breeding pools on salt marsh near Morris Cove.

b. *The same view as above showing ditch.*

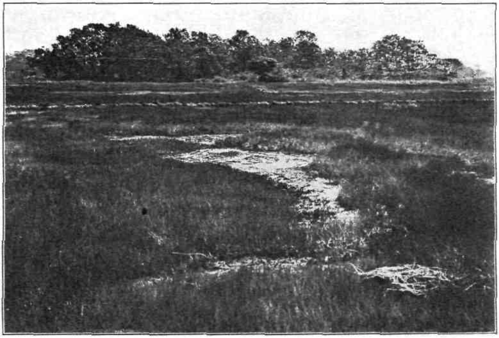
MOSQUITO DRAINAGE ON THE SALT MARSH.

a. The spade raised ready to be plunged into the peat.

b. Rolling away the turf.

DRAINING THE SALT MARSH WITH THE SKINNER SPADE.

a. The Skinner ditching spade.



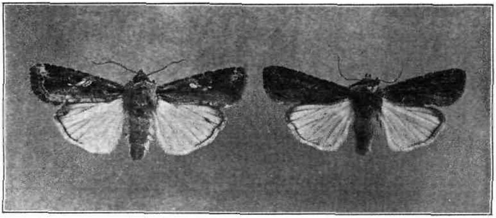
b. This pool half way between ditches has been drained.

DRAINING OF SALT MARSHES.

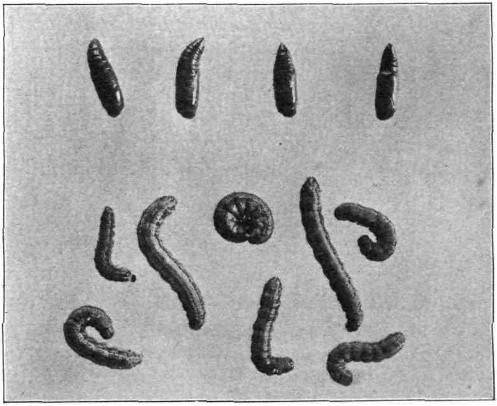
a. Sandy Point marsh. Stakes and flags mark breeding pools.

b. *Oiling pools in West River marsh.*

OILING BREEDING POOLS WITH "AUTO-SPRAY" OUTFITS.

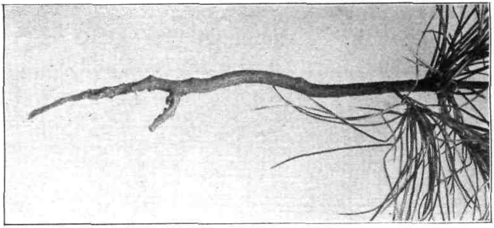


a. Adults, female at left. Somewhat enlarged.



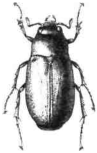
b. Larvæ and pupæ, natural size.

THE FALL ARMY WORM.

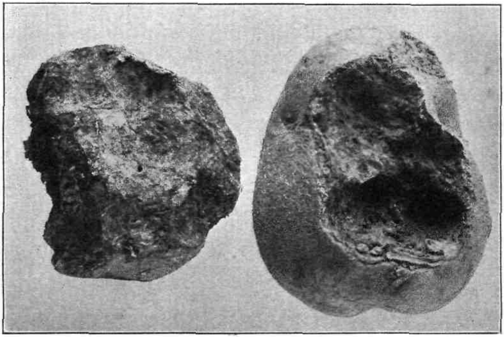


a. Seedling pine eaten off by grubs. Natural size.

b. White grub.
Natural size.



c. Adult June
beetle, natural
size.

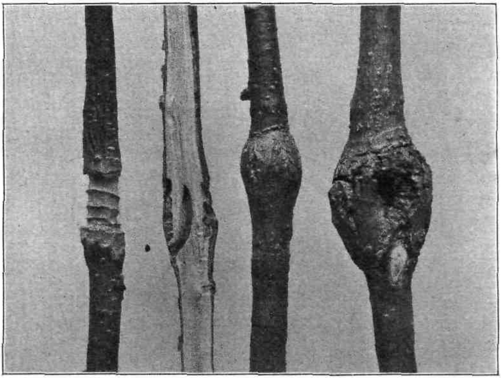


d. Potatoes eaten by white grubs.

THE WHITE GRUB.

a. Strawberry stem where millipedes were found.

b. Garden millipedes, natural size.



c. Galls of *Agrilus champlaini* on hop hornbeam.

GARDEN MILLIPEDE AND A BORER IN HOP HORNBEAM.

PART IV.

Commercial Feeding Stuffs.

By J. P. Street.*

THE LAW REGULATING THEIR SALE.

Under the Connecticut statutes the term "concentrated commercial feeding stuff" covers practically all feeds *excepting*:—hay and straw, whole seeds, unmixed meal made directly from any one of the cereals or from buckwheat, and feed ground from whole grain and sold directly from manufacturer to consumer.

Section 4592 requires that every package of concentrated commercial feeding stuff shall bear a statement giving the name and address of manufacturer or importer, the number of net pounds in the package, the name of the article and the percentage of protein and fat contained in it.

No registration of feeds or payment of analysis or license fees is required.

The penalty for violation of the statute is not more than $100 for the first offense and not more than $200 for each subsequent offense.

The law authorizes this station to take samples from any manufacturer, or dealer, in a prescribed fashion, and requires the station to analyze, annually, at least one sample of each brand which it has collected and to publish these analyses "together with such additional information in relation to the character, composition and use thereof as may be of importance."

The dairy and food commissioner is charged with the enforcement of the statute.

* The analytical work here described has been done by Messrs. Bailey, Morrison, Roe and Shepard.

In compliance with these requirements the following report has been prepared. The utmost brevity of discussion is made necessary by the limit imposed by law on the size of the report.

During the fall of 1912 the station sampling agent visited fifty towns and villages of this State and collected 226 samples of feeds as prescribed by law. The results of the examination of these samples are here discussed, and the chemical analyses are given in Table V.

The fifty-five analyses of samples sent by individuals are separately reported.

Oil Seed Products.

Cotton Seed Meal, Sampled by the Station.

(Analyses on page 318.)

Of the seventeen samples analyzed all satisfied their guaranties except **1237**, from the Kemper Mill & Elevator Co., Kansas City, and **1267**, from W. Newton Smith, Baltimore, Md., which were 2.75 and 3.37 per cent. low in protein, respectively. The average composition and selling price were practically the same as last year.

Cotton Seed Meal, Sampled by Purchasers.

The station is not responsible for the sampling but only for the analyses of samples not drawn by its agents.

Four brands of *Dixie Brand,* Humphreys, Godwin & Co., Memphis, were uniformly guaranteed 38.62 per cent. protein. **124**, sent by O. T. Downs, Brooklyn, contained 41.12 per cent.; **1085**, sent by L. C. Brainard & Co., Thompsonville, 41.19 per cent.; **1458**, sent by H. B. Coger, Newtown, 39.50 per cent.; and **1474**, sent by C. A. Pease & Co., Hartford, 42.50 per cent. This low guaranty is "safe" for the seller, but not exact enough for the buyer.

Two other samples, likewise credited to Humphreys, Godwin & Co., and sent by W. R. Messenger, Granby, were guaranteed 6.5 per cent. nitrogen, which is equivalent to 40.63 per cent. protein. **1482** contained 40.38 and **1483**, 36.69 per cent. protein, the latter being deficient by nearly 4 per cent.

Four other samples of Humphreys, Godwin & Co.'s meal came to us unguaranteed. **107** and **1485**, sent by The Coles Co.,

Middletown, contained 40.38 and 39.50 per cent. protein, respectively; **1486** and **1649**, sent by Olds & Whipple, Hartford, contained 38.38 and 40 per cent., respectively.

23 and **56**, *Owl Brand,* F. W. Brode & Co., Memphis, sent by B. T. Holcomb, West Simsbury, and R. L. Forsyth, Granby, the latter sample guaranteed 41 per cent. protein, contained 41.30 and 41.56 per cent., respectively.

328, W. Newton Smith, Baltimore, Md., guaranty 41 per cent. protein, sent by M. D. Leonard & Co., Watertown, contained 36.44 per cent., a deficiency of 4.56 per cent.

329, R. J. Hardy & Sons, Boston, guaranty 38 per cent. protein, sent by M. D. Leonard & Co., Watertown, contained 39.75 per cent.

1076 and **1459**, sent by The Coles Co., Middletown, contained 37.81 and 39.56 per cent. protein, respectively.

1451, *Bonita Brand,* Southern Cotton Oil Co., Charlotte, N. C., guaranty, 38.62 per cent. protein, sent by Apothecaries Hall Co., Waterbury, contained 40.88 per cent.

1470, bought through Apothecaries Hall Co., Waterbury, by H. H. Waldron, Bethlehem, contained 38.50 per cent. protein.

1473, sent by W. H. Lee, Orange, contained 42.50 per cent. protein.

1647, Southern Cotton Oil Co., Charlotte, N. C., sent by Apothecaries Hall Co., Waterbury, contained 41.75 per cent. protein.

Linseed Meal, Sampled by the Station.

(ANALYSES ON PAGE 318.)

The two samples of new process and the three of old process meal all satisfied their guaranties.

Peanut Meal, Sampled by Purchasers.

Two samples of peanut meal and two of peanut waste were analyzed. **21** was sent by J. W. Pincus, New York; **880**, J. E. Soper Co., Boston, sent by F. H. Stadtmueller, Elmwood; **30**, sent by Nut Product Co., New Haven; and **125**, sent by T. S. Scranton, Madison. These samples had the following composition:

	Peanut Meal.		Peanut Waste.	
	21	880	30	125
Water	—	8.09	3.57	4.85
Ash	—	—	5.77	5.66
Protein	34.94	46.25	28.44	22.44
Fiber	—	—	3.61	7.14
Nitrogen-free extract	—	—	19.23	31.93
Fat	—	8.87	39.38	27.98

880 was guaranteed 38 per cent. protein and 8 per cent. fat, selling price, $32.00, or $4.00 less per ton in car lots. This sample far exceeded its protein guaranty, and would seem to be an economical purchase at the price quoted, provided it proved acceptable to stock. Experience indicates that too much of this product scours dairy stock. None of the other samples was guaranteed, or was the selling price given.

Wheat Products.

Wheat Bran.

(Analyses on page 318.)

Of the twenty-six samples, five had no guaranty of composition as required by law, and two of these no brand name. These samples were **1258**, *Hamilton's Winter Bran,* **1161**, *Niagara Bran,* **1318**, *Voigt's Bran,* and **1221** and **1284**, manufacturer unknown. These samples were of normal quality, but this in no wise relieves the Connecticut dealer from the obligations of the law regarding branding. Of the remaining twenty-one samples, all but two satisfied their guaranties, **1149**, *Hecker's Choice Bran,* and **1295**, *Western Canada Flour Mills Bran,* being 0.65 and 0.52 per cent. deficient in fat, respectively.

The selling price ranged from $25 to $30, the higher prices as a rule providing no better feed.

Wheat Middlings.

(Analyses on page 320.)

Of the thirty-one samples, **1319**, *Voigt's Middlings,* and **1165**, *Standard Middlings,* did not bear the guaranty required by law, but were of good quality. **1176**, *Cox's Middlings,* was 1.09 per cent. below guaranty in fat, **1233**, *Hecker's H Middlings,* was

0.86 per cent. below in fat, and **1247**, *Lidgerwood Middlings*, was 1.50 per cent. below its protein guaranty. **1148** contained an unusual amount of fiber, probably due to imperfect cleaning of the wheat.

The selling prices ranged from $27 to $36 per ton, an even wider range than in the case of wheat bran. There is no important difference in composition between samples selling at these extreme prices.

Wheat Feed.

(ANALYSES ON PAGE 322.)

Of the twenty-four samples, **1167**, *Bull's Eye Mixed Feed*, was 1.19 per cent. below its protein guaranty, and **1313**, *Manhattan Mixed Feed*, was 0.78 per cent. below in fat.

The selling price ranged from $28 to $34 per ton, the $28 sample containing more protein than that sold for the maximum price.

Red Dog Flour.

(ANALYSES ON PAGE 324.)

The three samples analyzed satisfied their guaranties.

Wheat Products, Sampled by Purchasers.

904, *Bran*, bought of Waters and Bronson, Middlebury, and sent by H. E. Clark, Middlebury, guaranty 14.5 per cent. protein, contained 15.06 per cent. **1472**, *Bran*, sent by W. H. Lee, Orange, contained 15.69 per cent. protein.

MAIZE PRODUCTS.

Gluten Meal.

145, *Diamond Gluten Meal*, C. M. Cox & Co., Boston, sent by C. N. Burnham, Middlefield, contained 39.25 per cent. protein.

Gluten Feed.

(ANALYSES ON PAGE 324.)

Ten samples of six brands were analyzed, all of which satisfied their guaranties, the average protein, 25.83 per cent., exceeding the average guaranty by nearly 3 per cent.

Five samples were sent by purchasers: **146**, *Buffalo*, sent by C. N. Burnham, Middlefield, contained 25.94 per cent. protein;

128, *Globe*, sent by S. P. Woodward, Bethany, contained 30.94 per cent. protein; **892**, *Danbury A*, and **893**, *Danbury B*, sent by R. J. Hardy & Sons, Boston, contained 25.88 and 25.38 per cent. of protein, respectively; and **1471**, sent by W. H. Lee, Orange, contained 26.88 per cent. protein.

Hominy Feed.

(Analyses on page 326.)

Of the fifteen samples analyzed, one, **1306**, Simpson, Hendee & Co., New York, did not bear the guaranty required by law; this sample, however, was of excellent quality. The other fourteen samples all satisfied their guaranties. The average hominy feed this year contained 0.74 per cent. more protein, and 0.43 per cent. more fat than in 1911, and sold for $2.53 per ton less.

54, *Yellow Hominy Feed*, Quaker Oats Co., Chicago, guaranty 9 per cent. protein, sent by F. D. Weed, Danbury, contained 10.25 per cent. protein; **55**, *Steam Cooked Hominy Feed*, Miner-Hillard Milling Co., Wilkes Barre, Pa., guaranty 10 per cent. protein, also sent by Mr. Weed, contained 11.44 per cent. protein.

1087, sent by W. C. Burton, Torrington, was suspected by the purchaser of being adulterated. It contained 10.36 per cent. water, 2.00 ash, 8.75 protein, 2.94 fiber, 69.53 nitrogen-free extract and 6.42 fat. The deficiency in protein and fat appeared to be due only to the presence of excessive starch, corn starch being the only starch shown by the microscope.

1652, sent by H. B. Peck, Northfield, contained 11.06 per cent. protein.

Hominy Feed and Corn Cob.

(Analysis on page 326.)

The single sample of *Star Feed* analyzed exceeded its protein guaranty by more than 3 per cent. and its fat guaranty by more than 2 per cent. However, compared with hominy feed at $28, or even $30, it is not an economical purchase, as it contains more fiber and less protein, fat and carbohydrates than standard hominy feed.

Corn Bran.

One sample, **195**, sent by D. H. Colt, Elmwood, contained 9.19 per cent. protein.

RYE PRODUCTS.

(ANALYSES ON PAGE 326.)

Two samples of rye feed and one each of rye bran and rye middlings were analyzed. **1151**, *Bran*, *ground* by Morse and Landon, Guilford, did not bear the guaranty required by law. It contained less protein and fat and considerably more starch than the other three rye products, all of which satisfied their guaranties.

BUCKWHEAT PRODUCTS.

(ANALYSES ON PAGE 328.)

The two samples of middlings analyzed were of quite different quality. In **1342**, *Quinebaug Middlings*, the protein was 2.37 per cent. below its guaranty and 0.54 below its fat guaranty, although the product was very high grade. The other sample of somewhat poorer quality satisfied its guaranty.

OATS.

Three samples of oats, **930**, **931** and **932**, sent by Joseph Pepe, Waterbury, contained 12.59, 12.72 and 13.14 per cent. of water, respectively. We were asked to determine whether these were old-crop or new-crop oats. A considerable difference in water-content might have given some indication, but the differences in these samples are too small to be significant.

BARLEY PRODUCTS.

Malt Sprouts.

(ANALYSES ON PAGE 328.)

Of the three samples analyzed, **1144**, *Flint's Fancy Marvel*, was 0.73 per cent. below its fat guaranty, and **1169**, *Geneva Malting Co's Malt Sprouts*, was 0.98 per cent. below in fat. **1144**, however, exceeded its protein guaranty by 6.25 per cent., and was a sample of very high grade. **1317**, *Ballantine's Malt Sprouts*, was 1.13 per cent. low in protein. It contained a rather undue amount of barley hulls. The three samples averaged 26.55 per cent. protein, with an average selling price of $28. This feed should receive more consideration from dairymen, especially in comparison with many of the proprietary mixed feeds containing only from one-third to one-half as much protein as malt sprouts, and selling for from $30 to $35 a ton.

Dried Brewers' Grains.

(ANALYSES ON PAGE 328.)

All of the four samples analyzed satisfied their guaranties. Attention is again called to the fact that this feed is frequently underguaranteed in protein. The samples averaged 27.89 per cent. protein and 6.86 per cent. fat, exceeding the respective average guaranties by 3.39 and 1.18 per cent. The average price, $29.75 per ton, considered in connection with the feed's high analysis, marks it as one of the cheapest high-grade feeds on the market.

Dried Distillers' Grains.

(ANALYSES ON PAGE 328.)

The three samples analyzed all satisfied their guaranties. Though not as cheap a feed as either malt sprouts or dried brewers' grains, this feed is valuable and economical, especially when compared with proprietary feeds selling for the same price.

MISCELLANEOUS FEEDS.

Dried Beet Pulp.

(ANALYSES ON PAGE 328.)

The five samples of beet pulp satisfied their guaranties. This material is a carbohydrate rather than a protein feed. Feeding experiments in other states, notably New Jersey, have demonstrated its value, as its carbohydrates appear to be present in a very assimilable form.

Dried Molasses Beet Pulp.

(ANALYSIS ON PAGE 330.)

The single sample analyzed satisfied its guaranty. **22,** made by The Larrowe Milling Co., Detroit, and sent by The C. W. Campbell Co., Westerly, contained 10.06 per cent. protein.

Corn, Oats and Barley.

(ANALYSES ON PAGE 330.)

This material is exempt from the provisions of the law with respect to guaranty. The two samples analyzed were of very similar composition and were of standard quality.

Wheat and Corn Cob Feeds.

(ANALYSES ON PAGE 330.)

Both samples were properly branded and both satisfied their guaranties. The price of this class of feeds is more reasonable than in past years. It is for the feeder to determine whether he shall buy a wheat feed at $28 to $30, or such a feed as this in which the protein of wheat feed has been reduced from 17 to 11 per cent. by an admixture of ground corn cobs, and which sells for $24 or $25 per ton.

Corn and Oat Feeds.

(ANALYSES ON PAGE 330.)

Two samples of true provender (ground corn and oats) were analyzed and both were of good quality.

Chop Feeds.

(ANALYSES ON PAGE 330.)

The thirteen samples analyzed satisfied their guaranties. Chop feeds are chiefly mixtures of corn and oats products, with sometimes a little hominy. A mixture of corn and oats of good quality, half and half, should contain about 10 per cent. protein, 4.5 per cent. fat, and not over 5.5 per cent. fiber. A comparison of these figures with the analyses shows that inferior portions of these grains, corn cob and oat hulls, are often present in more than normal proportions. It is difficult to understand why any one buys such feeds as these when cotton seed meal, gluten feed, dried brewers' grains, malt sprouts, and dried distillers' grains may be bought for the same price or less, and when an abundant supply of carbohydrates and roughage can be cheaply raised on the farm.

Proprietary Horse Feeds.

(ANALYSES ON PAGE 332.)

Six samples were analyzed. **1234**, *Bonnie Horse Feed*, was 1.00 per cent. below its protein guaranty. The other samples all satisfied their guaranties.

A sample of *Sucrene Horse & Mule Feed*, **19**, American Milling Co., Chicago, sent by H. B. Coger, Botsford, contained 13.13 per cent. protein.

Proprietary Dairy and Stock Feeds.

(ANALYSES ON PAGE 332.)

Twenty-two samples were analyzed. The following deficiencies in fat were found: **1223,** *Biles' Ready Dairy Ration,* 0.48 per cent.; **1281,** *Blatchford's Calf Meal,* 0.28 per cent.; **1332,** *Green Meadow Dairy Feed,* 0.36 per cent.; **1172,** *Purina Molasses Feed,* 0.35 per cent.; and **1231,** *Presto Molasses Feed,* 0.27 per cent.; **1241,** *Schumacher's Calf Meal,* was 1.12 per cent. below guaranty in protein and 0.51 per cent. in fat. The remaining samples substantially satisfied their guaranties.

Dairy Feeds, Sampled by Purchasers.

A sample of *Sucrene Dairy Feed,* **20,** sent by H. B. Coger, Botsford, contained 18 per cent. protein. Two samples of *Biles' Union Grains,* **1083** and **1084,** sent by R. G. Waterous, Willimantic, contained 26.00 and 27.63 per cent. of protein, respectively. A sample of *Unicorn Dairy Ration,* **684,** sent by G. W. Thorpe, West Cheshire, contained 24.38 per cent. protein. A sample of *Western Stock Feed,* **756,** sent by The Coles Co., Middletown, contained 8.63 per cent. protein. Another sample, **349,** simply marked "Feed," contained 11.56 per cent. protein.

Proprietary Poultry Feeds.

(ANALYSES ON PAGE 334.)

Fourteen samples were analyzed. Two samples, **1266,** *Purity Poultry Mash,* and **1225,** *V. B. Growing Feed,* did not bear guaranties as required by law. **1199,** *Wirthmore Poultry Mash,* was 0.43 per cent. deficient in fat, but contained 7.38 per cent. more protein than guaranteed; **1288,** *Red Comb Meat Mash,* was 1.33 per cent. low in fat; and **1279,** *Park & Pollard's Dry Mash Feed,* was 1.75 per cent. low in protein. The other nine samples substantially satisfied their guaranties.

Poultry Feeds, Sampled by Purchaser.

[illegible], *Dry Mash,* made and sent by G. W. Thorpe, West Cheshire, contained 8.04 per cent. water, 18.06 protein and 5.05 fat.

Beef Scrap, Meat Meal and Fish Meal.

(ANALYSES ON PAGE 336.)

Twelve samples were analyzed. Three samples were below ir protein guaranty, **1154**, *Frisbie's Poultry Food*, by 3.12 cent., **1345**, *Ross Poultry Meal*, by 1.37 per cent., and **1250**, *iitman and Pratt's Beef Scrap*, by 1.31 per cent.; **1280**, Shay's *re Ground Beef Scrap*, was 2.83 per cent. below its fat guar-y. The samples of meat scrap show a very wide range in nposition, protein ranging from 28.63 to 57 per cent., fat from ɔ to 16.55 per cent., and ash from 17.96 to 51.06 per cent. is scrap is a variable mixture of bone and meat and cannot expected to have a very uniform composition.

Alfalfa Feed.

;ample **1487**, Kornfalfa Feed & Milling Co., Kansas City, t by C. M. Jarvis, New Britain, contained 7.83 per cent. water, 30 ash, 15.00 protein, 26.92 fiber, 37.79 nitrogen-free extract l 2.16 fat.

Bean Vine Meal.

;ample **1651**, sent by C. E. Kempton, Pomfret Centre, con-ıed 6.56 per cent. protein, which indicates a composition similar hat reported for a sample in last year's report. The price of h a feed is the controlling factor in the economy of its use, a tter of which we have no knowledge in this particular instance.

Twigs and Molasses.

This sample, **53**, consisted of small brush, bark and twigs, to ich ten gallons of molasses had been added per ton. It con-ıed 3.69 per cent. protein and 42.59 per cent. fiber. The sample s sent by C. M. Peck, Lyme. Shredded mature wood does contain any appreciable amount of nourishment. But bark . buds (which are immature leaves and flowers) contain the ritive juices of the tree and the stored food from which new wth is made and therefore contain more or less food which bivorous animals can assimilate. The chief food of deer and ɔse in winter is browse, i. e., buds and the twigs and branches trees. There is no reason, therefore, why domestic stock may eat and get some small amount of nourishment from such

material, just as well as from straw, bog hay, etc., and occasional reports come to us of it being relished by cows, especially when molasses or alfalfa meal or mill feed is mixed with it. It has been proposed in the vicinity of Hamburg, where there is a mill that will grind small shrubs and branches, that land may be cleared up and the undergrowth ground and used as a substitute for hay which is very scarce and high. Maple, birch, perhaps alder, as well as huckleberry bushes might answer, but one would imagine that chestnut, sumac or oak would tan the hides of the cattle prematurely! It is said that the cost of grinding is about $5.00 per ton. As long as the material is used only by farmers in the neighborhood with full knowledge of what they are using, the matter may well be left to their experiments and experience. As a commercial "filler" or "conditioner" for dairy rations, its use would condemn the feed.

Biscuit Refuse.

1481, sent by C. M. Jarvis, New Britain, contained 14.25 per cent. water, 4.36 ash, 7.67 protein, 0.46 fiber, 66.31 nitrogen-free extract, 6.95 fat, 1.23 nitrogen, 0.20 phosphoric acid and 0.33 potash.

Fresh Harvested Ears of Corn.

Sent by John Toth, Jr., Wallingford. The kernels contained, airdry, 23.84 per cent. of water and 8.91 per cent. of protein. This corn when crib-cured with 12 per cent. of water would contain 10.29 per cent. of protein. A yield of 7,000 pounds of ears at harvest would be reckoned as 100 bushels of shelled corn according to the practice which has been generally followed in corn contests. In this sample 7,000 pounds of ears actually contained only 89 bushels of crib-cured shelled corn with 12 per cent. of moisture. Some of the record yields of late-maturing corn would be much more largely reduced, if the excessive moisture in them were left out of the account.

Summary of Deficiencies in Branding or Guaranties.

Of the 227 samples collected by our agent and analyzed, two cotton seed meals were low in protein. Seven wheat feeds were without guaranties, two low in protein and three in fat. One each of hominy feed and rye products had no guaranty. One

buckwheat middlings was low in both protein and fat. One malt sprouts low in protein and two in fat. Of the proprietary horse, dairy and poultry feeds, two had no guaranties, two were deficient in protein, seven in fat and one in both protein and fat. Of the beef scraps three were deficient in protein and one in fat. Deficiences of less than 1 per cent, of protein and 0.25 per cent. of fat are not noted.

Digestibility of Feeding Stuffs by Ruminants.

Table I shows the digestion coefficients, or percentages of the food elements which are digestible by neat cattle (Lindsey's Compilation, 17th Report Mass. (Hatch) Agrl. Station, 1911, page 29 *et seq.*).

Some of these figures are the results of only a very few tests, and all of them represent short periods of feeding and must be regarded as showing comparative digestibility of the feeds only very roughly. Like chemical composition, statement of the digestibility of a feed is only a single "pointer" to the feeder, helpful, if it is not over-valued.

TABLE I.

DIGESTION COEFFICIENTS.

	Protein.	Fiber.	Nitrogen-free Extract.	Fat.
Cotton Seed Meal	84	35	78	94
Linseed Meal, new process	84	74	80	89
Linseed Meal, old process	89	57	78	89
Corn Meal	67	..	92	90
Hominy Meal	65	67	89	92
Gluten Feed	85	87	90	81
Wheat Bran	77	39	71	63
Wheat Middlings	77	30	78	88
Wheat Feed	78	62	77	87
Rye Feed	80	..	88	90
Oats	77	31	77	89
Buckwheat Middlings	85	17	83	89
Malt Sprouts	80	34	69	100
Dried Distillers' Grains	73	95	81	95
Dried Brewers' Grains	81	49	57	89
Provender	71	48	83	87
Wheat and Corn Cob Feed	63	28	71	92
Dried Beet Pulp	64	84	91	..
Oat Hulls	62	32	33	92
Cob Meal	17	65	60	50

	Water.	Ash.	Protein (N x 6.25).	Fiber.	Nitrogen-free Extract.	Ether Extract (fat).	Pounds of digestible Protein.	Fiber.	Nitrogen-free Extract.	Fat.	Cost per ton.
I. Protein over 30 per cent.											
Cotton Seed Meal	7.80	6.43	40.89	8.23	27.93	8.72	34.3	2.9	21.8	8.2	$33.12
Linseed Meal, new process	9.98	5.46	38.10	8.29	35.33	2.84	32.0	6.1	28.3	2.5	41.00
Linseed Meal, old process	9.77	5.28	34.60	7.74	35.88	6.73	30.8	4.4	27.9	6.0	39.00
Dried Distillers' Grains, Husted	7.36	1.38	31.25	11.15	36.71	12.15	22.8	11.6	29.7	11.5	34.00
Ajax Flakes	7.17	3.03	30.75	10.63	36.14	12.28	22.4	10.1	29.3	11.7	36.00
Buckwheat Middlings, high grade	12.81	5.02	30.38	8.89	35.30	7.60	25.8	1.5	29.3	6.8	32.00
Dried Distillers' Grains, Eagle	7.57	4.18	30.00	9.25	36.42	12.58	21.9	8.8	29.5	12.0	34.00
II. Protein 30–25 per cent.											
Dried Brewers' Grains	7.78	3.18	27.89	12.66	41.63	6.86	22.6	6.2	23.7	6.1	29.75
Gluten Feed, Buffalo	9.48	3.77	27.47	6.35	50.22	2.71	23.3	5.5	45.2	2.2	30.50
" " Cream of Corn	7.44	3.50	27.13	6.49	52.44	3.00	23.1	5.6	47.2	2.4	32.00
Unicorn Dairy Ration	7.60	5.27	26.66	8.91	45.31	6.25	....	....	....	....	33.00
Gluten Feed, Globe	7.48	4.17	26.57	6.90	52.38	2.50	22.6	6.0	47.1	2.0	33.00
Wirthmore Balanced Ration	8.41	5.46	26.56	8.18	45.58	5.81	....	....	....	....	33.00
Malt Sprouts	10.18	5.70	26.55	12.12	44.08	1.37	21.2	4.1	30.4	1.4	28.00
III. Protein 25–20 per cent.											
Blue Ribbon Dairy Feed	9.06	7.03	24.75	10.64	44.17	4.35	....	....	....	....	34.00
Gluten Feed, Hubinger's	7.80	1.72	24.75	6.34	55.18	4.21	21.0	5.5	49.7	3.4	29.00
" " Staley's	10.01	3.46	24.63	6.01	52.02	3.87	20.9	5.2	46.8	3.1	30.00
Biles' Ready Dairy Ration	8.67	5.71	24.31	9.67	45.12	6.52	....	....	....	....	33.00
Buckwheat Middlings, low grade	12.82	4.67	23.88	11.53	40.68	6.42	20.3	2.0	33.7	5.7	
Gluten Feed, Grand Rapids	8.59	0.99	22.00	7.54	57.12	3.76	18.7	6.6	51.4	3.0	30.00
V-B Dairy Feed	8.96	3.90	21.88	8.49	51.91	4.86	....	....	....	....	32.00
Husted Molasses Feed	11.69	7.05	20.25	7.41	49.55	4.05	....	....	....	....	31.00
IV. Protein 20–15 per cent.											
Larro Feed for Dairy Cows	8.08	4.44	19.38	12.46	52.21	3.43	....	....	....	....	32.00
Buf Ca Co Creamery Feed	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]					

							Pounds of digestible				
	Water.	Ash.	Protein (N x 6.25).	Fiber.	Nitrogen-free Extract.	Ether Extract (fat).	Protein.	Fiber.	Nitrogen-free Extract.	Fat.	Cost per ton.
Rye Middlings	10.37	4.02	17.00	5.17	59.91	3.53	....	....	....	....	31.00
Wheat Mixed Feed	9.98	5.25	16.70	7.28	56.01	4.78	13.0	4.5	43.1	4.2	30.23
Henkel's Fine White Feed	10.45	3.71	16.50	4.45	61.19	3.70	....	....	....	....	35.00
Quaker Dairy Molasses Feed	9.50	7.37	16.50	11.12	51.31	4.20	....	....	....	....	30.00
Wheat Bran	9.92	6.26	15.82	9.50	53.67	4.83	12.2	3.7	38.1	3.0	27.85
Rye Feed	10.28	4.61	15.60	5.45	60.61	3.45	12.5	....	53.3	3.1	33.00
V. Protein 15–10 per cent.											
Presto Molasses Feed	13.18	6.47	14.38	6.75	56.09	3.13	....	....	....	....	32.00
Rye Bran	10.99	2.82	13.44	2.62	67.49	2.64	....	....	....	....	30.00
Bonnie Horse Feed	10.47	2.72	13.00	5.73	63.63	4.45	....	....	....	....	33.00
Algrane Horse Feed	8.58	3.71	12.50	10.85	59.49	4.87	....	....	....	....	34.00
V-B Horse Feed	10.15	2.41	12.00	5.23	65.06	5.15	....	....	....	....	32.00
Zenith Stock Feed	10.72	3.56	11.81	5.40	62.99	5.52	....	....	....	....	35.00
Buf Ce Co Horse Feed	9.60	3.39	11.56	9.07	62.41	3.97	....	....	....	....	35.00
Green Meadow Dairy Feed	17.70	10.86	11.30	15.00	44.50	0.64	....	....	....	....	29.00
Hominy Feed	9.83	2.53	11.29	4.03	64.67	7.65	7.3	2.7	57.6	7.0	30.33
Grandin's Stock Feed	8.71	3.44	11.25	6.20	62.31	8.09	....	....	....	....	30.00
Corn, Oats and Barley	10.10	2.26	11.04	4.98	67.65	3.97	....	....	....	....	31.00
Wirthmore Stock Feed	8.22	3.24	10.94	7.92	63.20	6.48	....	....	....	....	30.00
Wheat and Corn Cob Feed	10.17	4.29	10.82	14.71	56.76	3.25	6.8	4.1	40.3	3.0	24.50
Provender (Ground Corn and Oats)	11.24	2.08	10.72	4.90	66.72	4.34	7.6	2.4	55.4	3.8	32.50
Husted Steam-Cooked Feed	10.33	2.28	10.63	5.48	66.51	4.77	....	....	....	....	35.00
Purina Molasses Feed	12.20	5.62	10.50	9.57	59.96	2.15	....	....	....	....	39.00
Schumacher's Stock Feed	9.06	3.19	10.38	9.45	64.34	3.58	....	....	....	....	31.00
Husted Molasses Horse Feed	10.65	4.97	10.31	6.26	64.06	3.75	....	....	....	....	30.00
Schumacher's Special Horse Feed	9.05	4.40	10.25	7.67	65.04	3.59	....	....	....	....	29.00
Star Feed	8.64	2.26	10.13	8.04	63.81	7.12	....	....	....	....	30.00
VI. Protein under 10 per cent.											

Average Composition, Digestibility and Selling Price of Commercial Feeds.

Table II contains a summary of the facts given in more deta in Table V, and shows, first, the average composition of thes feeds as determined by the present inspection, arranged accordin to their protein content; second, the amount of digestible matte in each feed, as far as we have been able to calculate it; an third, the average retail prices in November last.

The feeds are tabulated in six groups. The following state ment gives the average number of pounds of digestible protei fiber and nitrogen-free extract, and fat purchasable for one dolla in each of these groups:

Digestible Nutrients Purchasable for One Dollar.

Group.	Protein.	Fiber and Nitrogen-free Extract.	Fat.
1 Containing over 30 per cent. protein	15.3	19.5	4.9
2 " 25 to 30 " "	14.8	28.6	1.8
3 " 20 to 25 " "	13.7	37.2	2.2
4 " 15 to 20 " "	8.4	30.8	2.5
5 " 10 to 15 " "	5.0	37.4	3.1
6 " less than 10 " "	4.2	43.0	1.7

While too sweeping deductions should not be drawn fron these group averages, it is apparent that one dollar in the firs three groups supplies the feeder with from two to four times a much protein as in groups 4, 5 and 6. It is protein that th feeder requires to "balance" the feeding rations of his stock With an abundance of roughage on hand there is no apparen reason for the purchase of low-grade feeds. Generally speakin the dairyman should raise his own carbohydrate feeds and wher necessary should supplement these with those high-grade feeds i which he can purchase digestible protein at the lowest cost. Th fact pointed out in previous years is true this year: for $2 per ton the feeder may buy feeds containing from 8.50 to 29.7 per cent. protein, while for $32 he may buy feeds ranging fron 9.81 to 40.89 per cent. protein. Failure to observe this lack o relation between cost and the needed nutriment supplied ma explain why in many cases the dairy business is no longe profitable.

The Manurial Ingredients of Feeds.

The manurial value of a feed is largely determined by the amount of nitrogen it contains, although the ash constituents, phosphoric acid and potash, are also of considerable importance. The more concentrated feeds, when finely ground, are quite as good sources of available organic nitrogen as the best commercial fertilizers; the phosphoric acid and potash of feeds, however, are less valuable than the more soluble forms. The following table shows the average content of the fertilizing elements found in the dairy and stock feeds sold in this State. In many cases the analyses of standard feeds in other states, notably New Jersey, have been utilized; in thirty-three cases, however, analyses were made in the samples actually examined in the present inspection. In addition the manurial constituents of the more important home-grown feeds are also included.

It is at once noticeable that there are wide variations in the amounts of fertilizing ingredients contained in the different commercial feeds. Nitrogen ranges from 0.54 to 7.14 per cent., phosphoric acid from 0.15 to 3.09 per cent., and potash from 0.08 to 4.61 per cent. One hundred pounds of cotton seed meal, for instance, would supply 12.05 pounds of total plant-food, while the same quantity of oat hulls would furnish but 1.30 pounds. It must be remembered, however, that a certain portion of the fertilizing elements of the feed is retained in the animal itself or given off by other means than the excreta, the amount depending upon the kind of animal and the object of feeding. Lawes and Gilbert have shown at Rothamsted that in milking cows about 75 per cent. of the nitrogen and 90 per cent. of the phosphoric acid and potash are voided as excrement or perspiration, the remainder going into the milk or adding to the weight of the animal. With mature horses the same investigators showed that all of the nitrogen, phosphoric acid and potash is voided in the excrement or perspiration. As the feeds enumerated in the table are chiefly dairy feeds, they will be discussed entirely from the dairy standpoint.

Nitrogen is the most valuable and most important fertilizing element supplied by feeds, and it is in nitrogen that they show the greatest variation. In the fertilizer inspection of last year it was found that the average mixed fertilizer contained 2.95

TABLE III.—MANURIAL INGREDIENTS IN FEEDS.

Feed.	Nitrogen.	Phosphoric Acid.	Potash.
Oil Cake Meals.	%	%	%
Cotton Seed Meal	7.14	3.09	1.82
Linseed Meal, new process	5.70	2.16	1.49
" " old process	5.43	1.88	1.31
Wheat Products.			
Wheat Bran	2.56	2.92	1.57
Wheat Feed	2.72	2.04	0.54
Wheat Middlings	2.69	1.61	0.82
Red Dog Flour	2.86	1.42	0.80
Corn Products.			
Gluten Feed, Buffalo	4.39	1.64	1.02
" " Cream of Corn	4.34	1.48	0.98
" " Globe	4.25	1.27	1.05
" " Grand Rapids	3.52	0.36	0.08
" " Hubinger's	3.96	0.83	0.25
" " Staley's	3.94	1.36	0.87
Hominy Feed	1.75	1.40	0.75
Hominy Feed and Corn Cob (Star)	1.62	0.96	0.69
Corn Meal	1.44	0.63	0.37
Rye, Buckwheat, and Oat Products.			
Rye Bran	2.25	1.54	0.95
Rye Feed	2.45	1.56	1.07
Rye Middlings	2.72	1.87	1.22
Buckwheat Middlings, high grade	4.88	2.60	1.33
Ground Oats	1.78	0.76	0.50
Oat Hulls	0.54	0.24	0.52
Brewery and Distillery Products.			
Malt Sprouts	4.13	1.61	1.78
Dried Brewers' Grains	4.11	1.01	0.08
Ajax Flakes	4.92	1.18	0.59
Eagle Distillers' Grains	4.80	1.69	0.96
Husted Distillers' Grains	5.00	0.54	0.12
Miscellaneous Feeds.			
Dried Beet Pulp	1.29	0.24	0.57
Dried Beet Pulp and Molasses	1.54	0.15	1.81
Corn and Oats (Provender)	1.57	0.71	0.44
Corn and Oats Chop	1.42	0.87	0.63
Corn, Oats and Barley	1.77	0.69	0.50
Wheat and Corn Cob Feed	1.73	1.80	1.16
Dairy and Stock Feeds.			
Biles Ready Dairy Ration	3.89	1.79	1.20
Blatchford's Calf Meal	4.03	1.45	1.13
Blue Ribbon Dairy Feed	3.96	1.80	2.12
Buf Ce Co. Creamery Feed	3.00	1.73	1.07
Grandin's Stock Feed	1.80	1.15	0.73

TABLE III.—MANURIAL INGREDIENTS IN FEEDS—*Continued.*

Feed.	Nitrogen.	Phosphoric Acid.	Potash.
Dairy and Stock Feeds—Continued.	%	%	%
Green Meadow Dairy Feed	1.81	0.23	4.61*
Henkel's Fine White Feed	2.64	1.52	0.94
Husted Molasses Feed	3.24	1.24	1.47
Husted Steam Cooked Feed	1.70	0.69	0.49
Larro Feed for Dairy Cows	3.10	1.22	0.88
Presto Molasses Feed	2.30	1.93	1.77
Purina Molasses Feed	1.68	0.40	1.75
Quaker Molasses Dairy Feed	2.64	0.96	1.56
Schumacher's Calf Meal	2.86	1.60	0.56
Schumacher's Stock Feed	1.66	0.67	0.64
Sucrene Dairy Feed	2.90	1.20	1.81
Unicorn Dairy Ration	4.27	1.88	1.16
Zenith Stock Feed	1.89	1.01	0.66
V-B Dairy Feed	3.50	1.28	0.91
Wirthmore Balanced Ration	4.25	1.56	1.11
Wirthmore Stock Feed	1.75	1.09	0.72
Farm Crops.			
Corn Fodder, field-cured	0.86	0.36	1.07
Corn Silage	0.24	0.12	0.33
Corn Stalks, dried	0.82	0.28	0.95
" " field-cured	0.61	0.33	0.83
Hay, Alfalfa	2.66	0.54	2.46
" Cow Pea	2.48	0.66	2.36
" Red Clover	1.97	0.40	1.75
" Timothy	0.96	0.36	1.26
Straw, Oat	0.65	0.22	1.22
" Rye	0.50	0.29	0.79
" Wheat	0.43	0.13	0.74

* This figure is correct for the sample examined but appears quite abnormal.

per cent. nitrogen. The table shows that eighteen of the fifty-two feeds tabulated contain more than the manurial equivalent of this amount, 3.93 per cent. These include cotton seed and linseed meals, gluten feed, buckwheat middlings, the brewery and distillery products and a few of the feed mixtures. It is obvious, therefore, that a wise selection of feeds enhances the value of the manure and consequently plays an important part in farm economy.

There are also wide variations in the amounts of phosphoric acid and potash supplied by the different feeds. Phosphoric acid is supplied most abundantly in the oil-cake meals, wheat, rye and buckwheat products, malt sprouts and certain brands of gluten feed; nine of the feed mixtures also contain over 1.40 per cent.

of this element. On the other hand, oat hulls, dried beet pulp, certain distillers' grains and those gluten feeds to which the "steep" liquor is not added are very poor in phosphoric acid.

Potash is found in largest quantity in the oil-cake meals, wheat bran, buckwheat middlings, malt sprouts, dried beet pulp and molasses, and certain feed mixtures in which molasses is a prominent ingredient. Certain gluten feeds and distillers' grains, and dried brewers' grains contain but very small quantities of potash.

Of the home-grown crops alfalfa, cow pea and red clover hay are all rich in nitrogen and potash, and oat straw contains considerable potash; all, however, are low in phosphoric acid.

A comparison of the feeds, pound for pound, however, in many cases is hardly fair, for certain of the more concentrated feeds, cotton seed meal, for instance, can form but a small part of the ordinary dairy ration. Two pounds of cotton seed meal would supply no more nitrogen than six pounds of wheat bran, and only one-third of the phosphoric acid and less than half the potash. On the other hand wheat bran and wheat middlings could be fed in equal amounts, and here the bran would supply nearly double the amount of phosphoric acid and potash and only a little less nitrogen than the middlings. Malt sprouts and dried brewers' grains likewise would probably be fed in equal amounts, furnishing equal quantities of nitrogen, but by the feeding of the sprouts, two-thirds more phosphoric acid and twenty-two times as much potash would be supplied to the manure. The practical feeder, therefore, has a great opportunity to improve the quality of his farm manure simply by a wise selection of the feeds he uses for his stock, and this improvement, in the majority of cases, may be effected at no increased expense. It must be emphasized, nevertheless, that while the feeder has this opportunity of improving his farm manure, especially in its nitrogen content, this same nitrogen is the most elusive of all the fertilizing elements, and all the advantage of a wise selection of feeds may be lost through carelessness in the preservation of the manure.

The Cost of Feeds.

No feeder needs to be told that the prices of all feeds have advanced in recent years, but unless he has kept accurate records

perhaps he has not realized how great this advance has been. This station began its official inspection of feeds in 1899 and since then it has a record of the average prices asked for the various feeds in October and November of each year. Prior to 1899 all feed prices had been quite low but in that year an upward tendency was noted. The year 1902 showed greatly advanced prices, especially for cotton seed and linseed meals, brewery and distillery products, gluten feed and hominy feed, the latter feed

TABLE IV.—VARIATIONS IN SELLING PRICE, 1899–1912.

Feed.	Average Price, 1899–1912.				1912 price compare with lowest price 1899–1912.	
	Highest.	Year.	Lowest.	Year.	Increase.	Per cen Increase.
otton Seed Meal	$34.85	'09	$24.20	'99	$10.65	44
inseed Meal, new process	39.00	'12	25.75	'03	13.25	51
inseed Meal, old process	42.75	'11	26.25	'03	16.50	63
ried Distillers' Grains, high grade	34.67	'12	27.00	'06	7.67	28
ried Brewers' Grains	29.75	'12	*26.75	'06	*3.00	*11
alt Sprouts	28.00	'12	16.75	'01	11.25	67
luten Feed	32.71	'08	20.17	'99	12.54	62
uckwheat Middlings, high grade	32.00	'12	18.00	'00	14.00	78
heat Bran	30.97	'07	19.53	'99	11.44	59
heat Feed	31.74	'07	19.55	'99	12.19	62
heat Middlings	32.80	'11	19.76	'99	13.04	66
ominy Feed	32.86	'11	17.79	'99	15.07	85
rovender (Corn and Oats)	37.00	'11	19.00	'00	18.00	95

* *Not examined in this State before 1906; in New Jersey this feed sold for* $18.0 1 1899 and $19.06 in 1900, the Connecticut 1912 price showing an increase of $11.72 r 65 per cent.

showing an increase of $10.34 per ton over the price of 1899. The next year the prices of all of these feeds dropped considerably, but the prices of wheat products, bran, feed and middlings, then began an advance that has continued with slight fluctuations until the present time. The maximum prices for practically all of the feeds have been shown in the past three years. Table IV gives a summary of these average prices in thirteen of the standard feeds on which we had sufficient data to warrant their inclusion. These figures show that during the last three years the Connecticut feeder has been paying from 28 to 95 per cent. more

TABLE V.—ANALYSES OF COMMERCIAL FEEDS

BRAND.	RETAIL DEALER.
OIL SEED PRODUCTS.	
Cotton Seed Meal.	
Owl Brand. F. W. Brode & Co., Memphis, Tenn.	*Wallingford:* E. E. Hall...
Buckeye. Buckeye Cotton Oil Co., Cincinnati, O.	*Plainville:* Eaton Bros....
" " " " "	*Middletown:* Meech & Stod
" " " " "	*Suffield:* Spencer Bros.....
Acme Brand. T. H. Bunch, Little Rock, Ark.	*Willimantic:* H. A. Bugbe
Old Gold Brand. " " " " "	*Winsted:* E. Manchester &
Choice. Chickasha Cotton Oil Co., Chickasha, Okla.	*Milford:* E. L. Oviatt.....
Dixie Brand. Humphreys, Godwin & Co., Memphis, Tenn.	*Meriden:* Grain & Feed Co.
Forfat Brand. Humphreys, Godwin & Co., Memphis, Tenn.	*Meriden:* A. Grulich......
Imperial. Imperial Cotto Mill Co., Memphis, Tenn.	*Rockville:* E. White ....
Peacock Brand. Keeton McArthur Co., Atlanta, Ga.	*Bethel:* Johnston & Morrisc
Choice. Kemper Mill & Elev. Co., Kansas City, Mo.	*South Norwalk:* S. Roodne
Dirigo Brand. W. Newton Smith, Baltimore, Md.	*Middlefield:* A. E. Miller...
Pioneer Brand. J. E. Soper Co., Boston........	*Derby:* Peterson-Hendee C
" " " " "	*Willimantic:* E. A. Buck &
——— ——— " " "	*New Haven:* W. E. Critten
Bonita Brand. Southern Cotton Oil Co., Charlotte, N. C.	*Waterbury:* H. S. Coe & C
	Average guaranty ....
	Average of these 17 analyse
	Average digestible.........
Linseed Meal, New Process.	
American Linseed Co., Chicago.................	*Meriden:* Grain & Feed Co
" " "	*Stafford Springs:* G. L. De
	Average guaranty..........
	Average of these 2 analyses
	Average digestible.........
Linseed Meal, Old Process.	
American Linseed Co., New York	*Colchester:* David Shea....
The Guy G. Major Co., Toledo, O.	*Hamden:* I. W. Beers .....
Red Wing Linseed Co., Red Wing, Minn.	*New London:* P. Schwartz
	Average guaranty ....
	Average of these 3 analyses
	Average digestible........
WHEAT PRODUCTS.	
Wheat Bran.	
Atlas. Atlas Flour Mills, Milwaukee, Wis......	*New Haven:* W. E. Critten
Winona. Bay State Mill Co., Winona, Minn.....	*Ansonia:* Flour & Grain C
Niagara. Cataract City Mill Co., Niagara Falls, N. Y.	*Meriden:* A. Grulich ......
Commander. Commander Mill Co., Minneapolis,	

SAMPLED IN 1912.

	Pounds per Hundred.						
	Water.	Ash.	Protein. (N x 6.25.)	Fiber.	Nitrogen-free Extract. (Starch, gum, etc.)	Ether Extract. (Fat.)	Pri… p… to…
84	9.02	5.92	41.31	7.48	28.05	8.22	$32
20	7.20	6.17	38.44	10.79	29.22	8.18	34
71	7.35	6.30	39.00	10.96	28.27	8.12	3…
91	8.80	6.56	40.63	8.10	27.03	8.88	3…
14	7.27	6.63	39.50	8.57	29.29	8.74	3…
57	7.15	6.58	44.25	4.55	26.08	11.39	3…
24	7.60	5.51	45.38	8.24	25.86	7.41	34
01	8.70	6.22	37.75	8.62	28.28	10.43	34
02	7.05	6.23	39.38	11.13	28.28	7.93	3…
02	7.29	6.89	41.00	7.99	27.88	8.95	3…
49	8.84	6.53	41.13	7.29	27.94	8.27	3…
37	7.19	6.79	38.25	9.83	29.77	8.17	3…
67	8.42	6.22	37.63	10.69	28.72	8.32	3…
66	9.41	6.41	42.25	4.84	26.83	10.26	3…
12	5.31	7.07	47.25	5.91	26.89	7.57	3…
24	7.69	6.69	42.00	7.50	27.66	8.46	3…
62	8.27	6.53	39.94	7.43	28.92	8.91	31
..	....	....	**39.83**	....	.....	**7.09**	..
..	**7.80**	**6.43**	**40.89**	**8.23**	**27.93**	**8.72**	**3…**
..	....	....	**34.3**	**2.9**	**21.8**	**8.2**	..
98	9.88	5.48	38.69	8.20	34.95	2.80	4…
08	10.08	5.44	37.50	8.39	35.72	2.87	4…
..	....	....	**36.00**	....	.....	**1.00**	..
..	**9.98**	**5.46**	**38.10**	**8.29**	**35.33**	**2.84**	**41**
..	....	....	**32.0**	**6.1**	**28.3**	**2.5**	..
50	10.37	5.12	34.81	8.29	35.88	5.53	4…
86	10.32	4.64	33.00	7.89	37.20	6.95	3…
29	8.62	6.08	36.00	7.05	34.54	7.71	3…
..	....	....	**31.33**	....	.....	**5.33**	..
..	**9.77**	**5.28**	**34.60**	**7.74**	**35.88**	**6.73**	**39**
..	....	....	**30.8**	**4.4**	**27.9**	**6.0**	..
23	10.27	6.69	17.00	9.95	50.88	5.21	2…
50	9.82	6.19	16.25	10.02	52.79	4.93	2…
04	10.05	6.01	15.75	9.70	53.35	5.14	3…
32	9.15	6.64	15.88	10.22	52.68	5.32	3…

TABLE V.—ANALYSES OF COMMERCIAL FEEDS

	BRAND.	RETAIL DEALER.
	WHEAT PRODUCTS.—*Continued.*	
	Wheat Bran.	
:7	Monogram. C. M. Cox Co., Boston...........	*Plainville:* F. B. Newton .
;6	Eagle Roller Mill Co., New Ulm, Minn.	*Danbury:* F. C. Benjamin
;8	Winter. Wm. Hamilton & Son, Honedye Falls, N. Y.	*Waterbury:* I. A. Spencer Grain Co.............
19	Choice. Hecker-Jones-Jewell Mill Co., New York	*Branford:* S. V. Osborn..
;3	Ben Hur. Hennepin Mills Co., Minneapolis, Minn....	*Wallingford:* E. E. Hall..
15	Dreadnought. Hunter-Robinson-Wenz Mill Co., St. Louis, Mo.	*East Haven:* F. A. Forbe
2	Spring. Jennison Bros. & Co., Janesville, Minn.	*Torrington:* D. L. Talcot
8	Bran & Wheat Screenings. The K. B. R. Mill Co., Marquette, Kan.	*Winsted:* E. Manchester
3	Maney Mill Co., Omaha, Neb..................	*Hartford:* Smith, Northan
5	W. T. Naldrett, Norvell, Mich.	*No. Haven:* Coöperative F
7	Seal of Minn. New Prague Mill Co., New Prague, Minn..................................	*Manchester:* Little & McK
1	Choice. Niagara Falls Mill Co., Niagara Falls, N. Y..	*Ansonia:* Flour & Grain (
;6	Northwestern Cons. Mill Co., Minneapolis, Minn.	*Guilford:* Morse & Landc
0	Pillsbury's Minneapolis, Minn.	*Branford:* S. V. Osborn..
4	Sleepy Eye. Sleepy Eye Flour Mill Co., Sleepy Eye, Minn.	*Middletown:* Meech & Sto
7	Red Turkey. Southwestern Mill Co., Kansas City, Mo..	*New Britain:* C. W. Line
8	Fancy. Geo. Tileston Mill Co., St. Cloud, Minn.	*Middlefield:* A. E. Miller .
8	Voigt Milling Co., Detroit, Mich.	*New Haven:* R. G. Davis
3	Coarse. Washburn-Crosby Co., Minneapolis, Minn......................................	*Southington:* Lumber & F
5	Western Canada Flour Mills, Canada...........	*Suffield:* A. Sikes........
1	No tags. *Bought from Terry Co., Bridgeport...	*Plainville:* Eaton Bros....
4	No tags..	*Hartford:* Smith, Northam
		Average of these 26 analys
		Average digestible.......
	Wheat Middlings.	
2	Atlas Extra Flour. Atlas Flour Mill Co., Milwaukee, Wis..	*Suffield:* Spencer Bros....
8	Fancy Low Grade. Barber Mill Co., Minneapolis, Minn.	*New London:* P. Schwartz
9	Winona. Bay State Mill Co., Winona, Minn.....	*Ansonia:* Flour & Grain (
2	Puritan Flour. Brooks Elev. Co., Minneapolis, Minn.	*New Britain:* Stanley Sve
3	Standard. Cataract City Mill Co., Niagara Falls, N. Y.	*Meriden:* A. Grulich .....
6	Chas. M. Cox Co., Boston, Mass...............	*No. Haven:* Coöperative F
1	Crescent Milling Co., Fairfax, Minn...........	*Moosup:* T. E. Main & Sc
1	Duluth Superior Mill Co., Duluth, Minn........	*Bethel:* Johnston & Morri
3	Lucky Spring Flour. Federal Mill Co., Lockport,	

SAMPLED IN 1912—*Continued.*

Pounds per Hundred.						Price per ton.
Water.	Ash.	Protein. (N x 6.25.)	Fiber.	*Nitrogen-free* Extract. (Starch, gum, etc.)	*Ether* Extract. (Fat.)	
10.29	5.73	14.63	9.75	54.49	5.11	$28.00
9.46	6.94	15.31	10.55	52.70	5.04	25.00
10.96	5.92	14.88	9.15	54.87	4.22	30.00
9.61	5.99	15.25	9.34	55.11	4.70	30.00
9.80	7.00	15.13	11.23	51.97	4.87	26.00
9.54	5.91	14.88	8.28	57.44	3.95	27.0
10.00	6.79	16.75	9.85	51.15	5.46	27.0
9.75	5.95	17.88	8.43	53.65	4.34	26.0
9.88	6.55	16.50	9.67	52.66	4 74	28.0
8.34	5.98	15.88	7.86	57.40	4.54	29.0
9.60	6.05	16.50	10.09	52.67	5.09	28.0
9.39	6.44	15.75	8.58	54.94	4.90	28.0
9.76	6.47	16.13	9.54	52.90	5.20	28.0
10.92	6.64	16.00	9.94	51.41	5.09	30.0
11.18	6.81	15.25	10.46	51.38	4.92	26.0
8.96	6.68	17.50	8.75	53.66	4.45	28.0
10.58	6.06	14.63	10.21	53.65	4.87	26.0
9.64	5.88	15.00	8.13	56.97	4.38	25.0
10.07	6.18	15.88	10.48	51.77	5.62	30.0
10.40	5.42	16.50	8.89	54.31	4.48	29.0
10.48	5.60	14.38	8.00	57.26	4.28	28.0
10.09	6.26	15.88	9.79	53.35	4.63	28.0
9.92	**6.26**	**15.82**	**9.50**	**53.67**	**4.83**	**27.8**
....	....	**12.2**	**3.7**	**38.1**	**3.0**	....
10.83	4.11	17.94	6.48	55.72	4.92	34.0
11.45	2.66	18.13	1.57	61.24	4.95	35.0
11.08	5.25	17.63	7.40	53.29	5.35	30.0
10.22	4.58	17.75	7.28	55.47	4.70	36.0
9.46	5.16	17.25	7.89	54.86	5.38	33.0
11.87	2.42	15.25	2.37	64.68	3.41	33.0
10.12	5.06	18.38	7.22	53.10	6.12	27.0
11.01	2.79	18.00	2.60	60.83	4.77	36.0
10.28	4.29	19.13	6.28	54.44	5.58	30.0

Table V.—Analyses of Commercial Feeds

Brand.	Retail Dealer.
Wheat Products.—*Continued.*	
Wheat Middlings.	
The Gwinn Mill Co., Columbus, O.	*Bridgeport:* Vincent Bros.
"H." Hecker-Jones-Jewell Mill Co., New York	*So. Norwalk:* M. T. Hatch.
Ben Hur Standard. Hennepin Mills Co., Minneapolis, Minn.	*East Haven:* F. A. Forbes.
Flour. W. J. Jennison, Minneapolis, Minn.	*Middletown:* Meech & Stoddard
Carnation Gray. Kemper Mill & Elev. Co., Kansas City, Mo.	*Rockville:* E. White
Lidgerwood Mill Co., Lidgerwood, No. Dak.	*Springdale:* Monroe & Palm
Powerful Straight. New England Flour Co., Boston	*Rockville:* E. White
Niagara Falls Mill Co., Niagara Falls, N. Y.	*Wallingford:* Gallagher Bros
Pillsbury's "A," Minneapolis, Minn.	*Thompsonville:* H. K. Brainar
" "B," " "	*Branford:* S. V. Osborn
" XX Daisy " "	*East Hartford:* W. K. Ackle
Bixota. Red Wing Mill. Co., Red Wing, Minn.	*Plantsville:* T. B. Atwater.
Flour. Russell Miller Milling Co.	*Suffield:* A. Sikes
Pennant. David Stott, Detroit, Mich.	*Plainville:* F. B. Newton
Tennant & Hoyt Co., Lake City, Minn.	*Milford:* E. L. Oviatt
Angelus. Thompson Milling Co., Lockport, N. Y.	*Danbury:* C. W. Keeler
Fancy. Geo. Tileston Mill. Co., St. Cloud, Minn.	*Middlefield:* A. E. Miller
Geo. Urban Mill. Co., Buffalo, N. Y.	*Norwich:* Chas. Slosberg
Vimco. Valley City Mill. Co., Grand Rapids, Mich.	*Rockville:* E. White
Voigt Milling Co., Grand Rapids, Mich.	*New Haven:* R. G. Davis & S
Standard. Washburn-Crosby Co., Minneapolis, Minn.	*Guilford:* Morse & Landon.
Standard. No tags	*Shelton:* Ansonia Flour & Grain
	Average of these 31 analyses.
	Average digestible
Mixed Feed.	
Fancy Winter. E. W. Bailey, Montpelier, Vt.	*Yantic:* A. R. Manning
Bay State Mill. Co., Winona, Minn.	*Bristol:* Eaton Bros.
Bull's Eye. Blish Milling Co., Seymour Ind.	*Derby:* Peterson-Hendee Co.
Regent. Chas. M. Cox Co., Boston	*Hamden:* I. W. Beers
Boston. Duluth Superior Mill. Co., Duluth, Minn	*Bethel:* Johnston & Morrison.
Manhattan. Hecker-Jones-Jewell Mill. Co., New York	*Willimantic:* H. A. Bugbee.
Sunshine. Hunter-Robinson-Wenz Mill. Co., St. Louis, Mo.	*Thomaston:* L. E. Blackmer.
Crescent. Kemper Mill. & Elev. Co., Kansas City, Mo.	*Wallingford:* E. E. Hall.
Snowflake. Lawrenceburg Roller Mills Co., Lawrenceburg, Ind.	*Willimantic:* E. A. Buck & C
Thoroughbred. Lexington Roller Mills Co., Lexington, Ky.	*Bridgeport:* Vincent Bros.
W. T. Naldrett, Norvell, Mich.	*No. Haven:* Coöperative Feed
Donahue-Stratton Co., Milwaukee, Wis.	*Torrington:* D. L. Talcott.

SAMPLED IN 1912—*Continued.*

	Pounds per Hundred.						Price per ton.
	Water.	Ash.	Protein. (N x 6.25.)	Fiber.	Nitrogen-free Extract. (Starch, gum, etc.)	Ether Extract. (Fat.)	
10	9.43	3.96	18.25	5.38	57.19	5.79	$35.
13	10.07	4.93	18.25	7.83	53.78	5.14	30.
17	10.63	5.19	17.50	8.05	53.79	4.84	28.
70	11.26	3.70	17.63	4.22	58.23	4.96	31.
94	9.03	4.59	19.88	5.09	56.35	5.06	29
17	9.86	4.18	18.50	6.03	55.76	5.67	34
05	9.47	5.09	20.38	5.90	53.90	5.26	28
31	9.82	4.63	18.13	7.47	53.84	6.11	30
55	11.19	4.28	18.00	5.67	56.08	4.78	32
48	10.32	5.13	14.75	11.26	52.17	6.37	30
78	12.29	3.29	18.75	3.07	57.72	4.88	36
94	10.15	4.86	19.50	6.51	52.97	6.01	32
94	12.03	3.06	18.00	3.07	58.84	5.00	34
15	10.60	4.36	16.94	5.83	57.32	4.95	30
23	10.46	4.74	18.56	6.55	53.11	6.58	32
53	11.74	4.17	17.75	5.97	54.61	5.76	32
69	10.77	3.98	17.31	5.23	57.33	5.38	29
39	10.66	3.58	16.63	4.55	60.33	4.25	27
01	10.76	4.29	16.38	5.59	58.47	4.51	30
19	11.71	3.49	15.94	4.37	59.91	4.58	9
55	10.01	5.50	17.63	7.66	53.90	5.30	30
65	11.37	4.20	16.50	6.99	55.40	5.54	3
..	**10.64**	**4.24**	**17.76**	**5.85**	**56.29**	**5.22**	**31**
..	....	....	**13.7**	**1.8**	**43.9**	**4.6**	..
35	9.65	5.77	17.00	7.81	54.95	4.82	2
65	10.61	4.79	17.19	6.46	55.88	5.07	3
67	10 51	5.22	15.81	7.22	56.76	4 48	3
88	10 42	5.17	17.63	7.83	53.71	5.24	3
48	10.28	5.10	16.75	7.94	54.43	5.50	3
113	9.35	5.05	17.00	7.52	56.21	4.87	2
168	9.79	6.10	18.13	7.81	53.30	4.87	3
182	9.29	5.06	16.63	7.02	57.76	4.24	2
310	8.80	5.38	16.00	7.15	58.19	4.48	2
228	9.52	4.87	15.50	6.52	59.27	4.32	[illegible]
174	10.04	4.40	15.38	5.50	60.70	3.98	[illegible]
363	10.76	6.71	16.25	8.24	52.66	5.36	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

TABLE V.—ANALYSES OF COMMERCIAL FEEDS

BRAND.	RETAIL DEALER.
WHEAT PRODUCTS.—*Continued.*	
Mixed Feed.	
Niagara Falls Mill. Co., Niagara Falls, N. Y.	*Guilford:* G. F. Walter
Fancy. Pillsbury's, Minneapolis, Minn.	*Plainville:* Eaton Bros.
Royal. Royal Milling Co., Great Falls, Mont.	*Winsted:* Theo. Wachter
Occident. Russell Miller Mill. Co.	*Cheshire:* G. W. Thorpe
Gold Mine. Sheffield King Mill. Co., Minneapolis, Minn.	*Ansonia:* Flour & Grain Co.
Try Me. Sparks Milling Co., Alton, Ill.	*Hamden:* I. W. Beers
Wabash. " " " Terre Haute, Ind.	*Winsted:* E. Manchester & S
Honest. David Stott, Detroit, Mich.	*Plainville:* F. B. Newton
Angelus. Thompson Mill. Co., Lockport, N. Y.	*Danbury:* C. W. Keeler
Farmers' Favorite Cow Feed. Valley City Mill Co., Grand Rapids, Mich.	*Rockville:* E. White
Waggoner Gates Mill. Co., Independence, Mo.	*Danbury:* F. C. Benjamin &
	Average of these 24 analyses
	Average digestible
Red Dog Flour.	
Niagara Falls Mill. Co., Niagara Falls, N. Y.	*Waterbury:* H. S. Coe & Co.
XXX Comet. Northwestern Cons. Mill Co., Minneapolis, Minn.	*Middletown:* Meech & Stodda
Adrian. Washburn Mills, Minneapolis, Minn.	*New London:* Arnold Rudd (
	Average of these 3 analyses
MAIZE PRODUCTS.	
Gluten Feed.	
Buffalo. Corn Products Refining Co., New York	*No. Haven:* Coöperative Feed
" " " " " " "	*Waterbury:* H. S. Coe & Co
	Average guaranty
	Average of these 2 analyses
	Average digestible
*Cream of Corn. American Maize Products Co., New York	*Manchester;* G. W. Kuhney
Cream of Corn. American Maize Products Co., New York	*Stafford Springs:* G. L. Denn
	Average guaranty
	Average of these 2 analyses
	Average digestible
Globe. Corn Products Refining Co., New York	*Derby:* Peterson-Hendee Co
" " " " "	*Norwalk:* Holmes, Keeler & Kent Co.
	Average guaranty
	Average of these 2 analyses
	Average digestible
Grand Rapids. Douglas & Co., Grand Rapids, Ia.	*Winsted:* Platt & Coe
	Guaranty
	Digestible
Hubinger. J. C. Hubinger Bros. Co., Keokuk, Ia.	*New Haven:* W. E. Crittende
	Guaranty
	Digestible

SAMPLED IN 1912—*Continued.*

Pounds per Hundred.						Price per ton.
Water.	Ash.	Protein. (N x 6.25.)	Fiber.	Nitrogen-free Extract. (Starch, gum, etc.)	Ether Extract. (Fat.)	
9.77	5.38	16.13	7.43	56.27	5.02	$34.
11.30	5.93	17.00	7.18	54.00	4.59	32.
9.89	4.66	17.81	7.28	55.27	5.09	31.
10.51	4.60	17.50	7.02	55.52	4.85	30.
10.39	5.05	17.13	7.79	54.77	4.87	31.
10.16	5.12	16.75	7.04	56.55	4.38	30.
8.60	5.16	16.75	7.17	57.92	4.40	29.
10.40	5.30	16.25	7.51	55.49	5.05	30.
10.48	5.45	16.69	8.71	53.37	5.30	31.
9.65	5.34	16.13	7.62	56.54	4.72	29.
9.97	5.20	15.63	6.64	57.85	4.71	28.
9.98	5.25	16.70	7.28	56.01	4.78	30.
....	....	13.0	4.5	43.1	4.2	...
10.35	1.83	17.13	0.93	65.70	4.06	36.
10.84	3.04	19.25	2.40	58.51	5.96	34.
11.00	2.77	17.19	3.01	61.24	4.79	36.
10.73	2.55	17.86	2.11	61.81	4.94	35.
10.18	4.47	27.75	5.75	48.85	3.00	29.
8.79	3.07	27.19	6.96	51.58	2.41	32.
....	....	24.00	....	.....	2.00	...
9.48	3.77	27.47	6.35	50.22	2.71	30.
....	....	23.3	5.5	45.2	2.2	...
8.64	3.80	27.88	6.41	51.15	2.12	30.
6.24	3.21	26.38	6.57	53.72	3.88	34.
....	....	23.00	....	.....	2.00	...
7.44	3.50	27.13	6.49	52.44	3.00	32.
....	....	23.1	5.6	47.2	2.4	...
8.62	3.95	26.13	6.67	51.95	2.68	31.
6.35	4.39	27.00	7.13	52.81	2.32	35.
....	....	23.00	....	.....	2.00	...
7.48	4.17	26.57	6.90	52.38	2.50	33.
....	....	22.6	6.0	47.1	2.0	...
8.59	0.99	22.00	7.54	57.12	3.76	30.
....	....	20.00	....	.....	2.50	...
....	....	18.7	6.6	51.4	3.0	...
7.80	1.72	24.75	6.34	55.18	4.21	29.
....	....	23.00	....	.....	2.40	...
....	....	21.0	5.5	49.7	3.4	...

TABLE V.—ANALYSES OF COMMERCIAL FEEDS

BRAND.	RETAIL DEALER.
MAIZE PRODUCTS.—*Continued.*	
Gluten Feed.	
Staley's. A. E. Staley Mfg. Co., Decatur, Ill....	*Bristol:* Eaton Bros.........
" " " " " ...	*Rockville:* E. White.........
	Average guaranty ....
	Average of these 2 analyses.
	Average digestible..........
Hominy Feed.	
Homco. American Hominy Co., Indianoplis, Ind.	*Colchester:* Grain & Coal Co
	Guaranty ....
Buf Ce Co. Buffalo Cereal Co., Buffalo, N. Y.	*Stamford:* W. L. Crabb ....
	Guaranty..................
Wirthmore. Chas. M. Cox Co., Boston.........	*No. Haven:* CoöperativeFeed
	Guaranty..................
Evans. Evans Mill. Co., Indianapolis, Ind......	*Greenwich:* J. P. Johnson..
	Guaranty ....
*R. J. Hardy & Sons, Boston, Mass.	*Suffield:* Spencer Bros......
	Guaranty ....
Badger. Chas. A. Krause, Milwaukee, Wis.....	*Springdale:* Monroe & Palme
	Guaranty ....
Steam-cooked. Miner-Hillard Mill. Co., Wilkes-barre, Pa..................................	*New Haven:* J. T. Benham E
	Guaranty ....
Mystic Milling Co., Sioux City, Ia.	*Yantic:* A. R. Manning.....
	Guaranty ....
Patent Cereals Co., Geneva, N. Y.	*Hamden:* I. W. Beers ......
	Guaranty ....
Yellow. Quaker Oats Co., Chicago............	*Milford:* E. L. Oviatt ....
" " " "	*Danbury:* F. C. Benjamin &
	Average guaranty ....
	Average of these 2 analyses ..
*Simpson, Hendee & Co., New York...........	*Rockville:* E. White........
Blue Ribbon. J. E. Soper Co., Boston..........	*Norwich:* Chas. Slosberg....
	Guaranty ....
Sparr Cereal Co., Marshfield, Wis..............	*Manchester:* Little & McKinı
	Guaranty ....
Logan. Standard Cereal Co., Chillicothe, O....	*Norwich:* Norwich Grain Co
	Guaranty ....
	Average guaranty of all hon feeds ....
	Average of these 15 analyses .
	Average digestible..........
Hominy Feed and Corn Cob.	
Star Feed. Toledo Elevator Co., Toledo, O......	*Winsted:* Platt & Coe.......
	Guaranty ....
RYE PRODUCTS.	
Bran. Morse & Landon, Guilford	*Guilford:* Morse & Landon..
Feed. Boutwell Mill. & Grain Co., Troy, N. Y..	*Meriden:* Grain & Feed Co...
Middlings. Washburn-Crosby Co., Minneapolis, Minn..................................	*Waterbury:* H. S. Coe & Co.

SAMPLED IN 1912—*Continued.*

Station No.	Pounds per Hundred. Water.	Ash.	Protein. (N x 6.25.)	Fiber.	Nitrogen-free Extract. (Starch, gum, etc.)	Ether Extract. (Fat.)	Pr p to
:64	9.19	2.99	23.00	6.47	54.96	3.39	$3
03	10.84	3.93	26.25	5.56	49.07	4.35	28
..	....	....	**23.00**	....	.....	**2.50**	..
..	**10.01**	**3.46**	**24.63**	**6.01**	**52.02**	**3.87**	30
..	....	....	**20.9**	**5.2**	**46.8**	**3.1**	..
48	9.82	2.82	11.50	4.24	62.73	8.89	2
..	....	....	**9.50**	....	.....	**7.00**	..
43	9.45	2.69	11.38	4.17	63.47	8.84	3
..	....	....	**10.00**	....	.....	**7.00**	..
78	9.27	2.72	11.31	4.72	63.14	8.84	3
..	....	....	**10.00**	....	.....	**7.50**	..
:44	10.04	2.51	11.38	4.41	63.43	8.23	3
..	....	....	**10.00**	....	.....	**7.50**	..
:93	10.49	2.28	10.88	4.67	64.43	7.25	3
..	....	....	**10.00**	....	.....	**7.00**	..
:46	10.40	3.08	11.88	4.40	63.39	6.85	3
..	....	....	**9.00**	....	.....	**6.00**	..
73	8.64	2.58	11.88	4.33	66.74	5.83	3
..	....	....	**10.00**	....	.....	**5.00**	..
:34	8.75	2.62	11.63	4.03	64.77	8.20	2
..	....	....	**11.00**	....	.....	**7.00**	..
89	10.60	2.54	10.88	3.95	63.82	8.21	3
..	....	....	**10.00**	....	.....	**7.00**	..
:22	11.52	1.76	10.25	2.19	69.45	4.83	2
:57	11.14	2.14	10.75	3.27	66.97	5.73	2
..	....	....	**9.00**	....	.....	**4.00**	..
..	**11.33**	**1.95**	**10.50**	**2.73**	**68.21**	**5.28**	21
:06	8.38	2.87	11.56	4.52	63.65	9.02	2
:37	10.36	2.62	11.38	4.27	63.38	7.99	2
..	....	....	**10.00**	....	.....	**8.00**	..
:98	9.37	2.45	11.75	3.63	63.96	8.84	3
..	....	....	**10.00**	....	.....	**8.00**	..
:40	9.26	2.30	11.00	3.65	66.64	7.15	2
..	....	....	**9.00**	....	.....	**7.00**	.
...	....	....	**9.75**	....	.....	**6.57**	.
...	**9.83**	**2.53**	**11.29**	**4.03**	**64.67**	**7.65**	3
..	....	....	**7.3**	**2.7**	**57.6**	**7.0**	..
:52	8.64	2.26	10.13	8.04	63.81	7.12	3
..	....	....	**7.00**	....	.....	**5.00**	.
:51	10.99	2.82	13.44	2.62	67.49	2.64	3
:97	11.19	3.54	15.31	3.85	62.89	3.22	3
:59	10.37	4.02	17.00	5.17	59.91	3.53	3

TABLE V.—ANALYSES OF COMMERCIAL FEEDS

Brand.	Retail Dealer.
BUCKWHEAT PRODUCTS.	
Middlings. Miner-Hillard Mill Co., Wilkesbarre, Pa.	*So. Norwalk:* M. T. Hatch.
	Digestible
Middlings. Quinebaug Grist Mill, Danielson	*Danielson:*
	Digestible
BARLEY PRODUCTS.	
Malt Sprouts.	
P. Ballantine & Sons, Newark, N. J.	*New Haven:* R. G. Davis &
	Guaranty
Fancy Marvel. Flint Mill. Co., Milwaukee, Wis.	*East Haven:* F. A. Forbes.
	Guaranty
Geneva Malting Co., Geneva, N. Y.	*New Haven:* J. T. Benham
	Guaranty
	Average of these 3 analyses
	Average digestible
Dried Brewers' Grains.	
XXX. Chicago Grain & Feed Co., Chicago	*Suffield:* Spencer Bros.
	Guaranty
Bull Brand. Farmers' Feed Co., New York	*Norwalk:* Holmes, Keeler & Kent Co.
	Guaranty
Providence Brewing Co., Providence, R. I.	*East Haven:* F. A. Forbes.
	Guaranty
C. W. Wagar & Co., Philadelphia	*Danielson:* Young Bros. Co
	Guaranty
	Average of these 4 analyses
	Average digestible
Dried Distillers' Grains.	
Ajax Flakes. Ajax Mill. & Feed Co., Buffalo, N. Y.	*Hazardville:* A. D. Bridges Sons Co.
	Guaranty
Eagle Grains, 3 D. The Dewey Bros. Co., Blanchester, O.	*Winsted:* E. Manchester &
	Guaranty
Husted. Husted Milling Co., Buffalo, N. Y.	*Winsted:* E. Manchester &
	Guaranty
	Average of these 3 analyses
	Average digestible
MISCELLANEOUS FEEDS.	
Dried Beet Pulp.	
Continental Sugar Co., Findlay, O.	*Norwalk:* Holmes, Keeler & Kent Co.
Menominee River Sugar Co., Menominee, Mich.	*Torrington:* D. L. Talcott.
Mt. Clemens Sugar Co., Mt. Clemens, Mich.	*Winsted:* E. Manchester &
Owosso Sugar Co., Lansing, Mich.	*Torrington:* F. U. Wadhams
Charles Pope, Chicago	*Hartford:* Smith, Northam &
	Guaranty of all samples
	Average of these 5 analyses
	Average digestible

SAMPLED IN 1912—*Continued.*

Pounds per Hundred.						Price per ton.
Water.	Ash.	Protein. (N x 6.25.)	Fiber.	Nitrogen-free Extract. (Starch, gum, etc.)	Ether Extract. (Fat.)	
12.82	4.67	23.88	11.53	40.68	6.42	....
....	....	**20.3**	**2.0**	**33.7**	**5.7**	
12.81	5.02	30.38	8.89	35.30	7.60	$32.
....	....	**25.8**	**1.5**	**29.3**	**6.8**	...
7.48	6.04	24.50	15.00	45.61	1.37	27.
....	....	**25.63**	.....	.....	**1.47**	...
12.22	5.75	28.25	10.38	42.13	1.27	28.
....	....	**22.00**	.....	.....	**2.00**	...
10.84	5.32	26.88	10.98	44.51	1.47	29.
....	....	**26.50**	.....	.....	**2.45**	...
10.18	**5.70**	**26.55**	**12.12**	**44.08**	**1.37**	**28.**
....	....	**21.2**	**4.1**	**30.4**	**1.4**	...
8.27	3.04	29.19	12.32	40.19	6.99	30.
....	....	**25.00**	.....	.....	**5.00**	...
7.54	2.92	29.25	12.07	40.24	7.98	33.
....	....	**27.00**	.....	.....	**6.30**	...
7.49	3.53	23.38	13.12	45.89	6.59	28.
....	....	**22.00**	.....	.....	**5.00**	...
7.80	3.21	29.75	13.12	40.23	5.89	28.
....	....	**24.00**	.....	.....	**6.00**	...
7.78	**3.18**	**27.89**	**12.66**	**41.63**	**6.86**	**29.**
....	....	***22.6***	***6.2***	***23.7***	***6.1***	....
7.17	3.03	30.75	10.63	36.14	12.28	36.
....	....	**30.00**	.....	.....	**11.00**	...
7.57	4.18	30.00	9.25	36.42	12.58	34.
....	....	**30.00**	.....	.....	**10.00**	...
7.36	1.38	31.25	11.15	36.71	12.15	34.
....	....	**30.00**	.....	.....	**8.00**	...
7.37	**2.86**	**30.67**	**10.34**	**36.42**	**12.34**	**34.**
....	....	**22.4**	**9.8**	**29.5**	**11.7**	...
8.54	3.23	8.25	19.59	59.60	0.79	30.
7.97	2.61	8.44	18.86	61.07	1.05	29.
10.00	3.25	8.75	19.04	57.92	1.04	27.
9.83	2.85	8.63	18.31	59.39	0.99	28.
8.44	3.35	8.44	20.12	58.85	0.80	31.
....	....	**8.00**	.....	.....	**0.50**	...
8.96	**3.06**	**8.50**	**19.18**	**59.37**	**0.93**	**29.**

TABLE V.—ANALYSES OF COMMERCIAL FEEDS

BRAND.	RETAIL DEALER.
MISCELLANEOUS FEEDS.	
Dried Beet Pulp and Molasses.	
Michigan Sugar Co., Alma, Mich.	*New Britain:* C. W. Lines (
	Guaranty
MIXED FEEDS.	
Corn and Oat Feeds, and Chop Feeds.	
Buf Ce Co. Chop Feed. Buffalo Cereal Co., Buffalo, N. Y.	*Shelton:* Ansonia Flour & (Co.
	Guaranty
Iroquois Chop Feed. Buffalo Cereal Co., Buffalo, N. Y.	*New Haven:* R. G. Davis &
	Guaranty
Buf Ce Co. Stock Feed. Buffalo Cereal Co., Buffalo, N. Y.	*New Haven:* J. T. Benham
	Guaranty
Provender. Colchester Grain & Coal Co., Colchester	*Colchester:*
Stock Feed. W. H. Haskell & Co., Toledo, O.	*Norwich:* Chas. Slosberg.
	Guaranty
Purity Stock Feed. Wm. S. Hills Co., Boston	*Plantsville:* C. O. Cowles.
	Guaranty
New England Stock Feed. H. O. Co., Buffalo, N. Y.	*Plainville:* Eaton Bros.
	Guaranty
Mayflower Stock Feed. Husted Mills, Buffalo, N. Y.	*Plantsville:* C. O. Cowles.
	Guaranty
Korn-Oato Feed. Meech & Stoddard, Middletown	*Middletown:*
	Guaranty
Provender. Morse & Landon, Guilford	*Guilford:*
Mystic Feed. Mystic Mill. & Feed Co., Rochester, N. Y.	*Torrington:* F. U. Wadham:
	Guaranty
Boss Feed. Quaker Oats Co., Chicago	*New Haven:* W. E. Crittend
	Guaranty
White Diamond Feed. Quaker Oats Co., Chicago	*New London:* P. Schwartz C
	Guaranty
Victor Feed. Quaker Oats Co., Chicago	*So. Manchester:* G. W. Stran
	Guaranty
Winner Chop Feed. David Stott, Detroit, Mich.	*Plainville:* F. B. Newton.
	Guaranty
Corn, Oats and Barley.	
C. W. Campbell Co., Westerly	*Westerly:*
Edward White, Rockville	*Rockville:*
	Average of these 2 analyses
Wheat and Corn Cob Feeds.	
Sterling Feed. Indiana Mill. Co., Terre Haute, Ind.	*Middletown:* Meech & Stodd
	Guaranty
Kennebec Feed. I. E. Soper Co., Boston	*New Haven:* W. E. Crittend
	Guaranty
	Average of these 2 analyses

SAMPLED IN 1912—*Continued.*

Pounds per Hundred.						Price per ton.
Water.	Ash.	Protein. (N x 6.25.)	Fiber.	*Nitrogen-free* Extract. (Starch, gum, etc.)	*Ether* Extract. (Fat.)	
8.84	4.52	9.63	16.34	59.79	0.88	$28.0
....	....	**9.00**	.....	.....	**0.50**	....
9.56	3.35	9.13	9.17	64.99	3.80	31.0
....	....	**7.00**	.....	......	**3.00**	....
8.74	3.24	10.13	8.70	64.22	4.97	28.0
....	....	**7.00**	.....	.....	**3.00**	....
9.04	3.22	9.81	7.99	64.70	5.24	32.0
....	....	**8.00**	.....	.....	**4.00**	....
10.97	2.34	10.81	5.76	65.54	4.58	32.0
8.89	2.91	10.00	6.12	66.10	5.98	32.0
....	....	**8.00**	.....	.....	**4.00**	....
8.19	4.02	10.69	10.02	62.06	5.02	34.0
....	....	**8.00**	.....	.....	**3.00**	....
8.05	3.60	10.19	10.16	63.37	4.73	33.0
....	....	**9.00**	.....	.....	**4.00**	....
10.41	3.51	10.81	5.47	64.28	5.52	32.0
....	....	**7.50**	.....	.....	**3.50**	....
10.36	2.61	7.88	9.87	65.77	3.51	30.0
....	....	**7.00**	.....	.....	**3.00**	....
11.52	1.82	10.63	4.04	67.90	4.09	33.0
9.97	3.37	11.00	8.82	62.86	3.98	31.0
....	....	**8.00**	.....	.....	**3.00**	....
9.93	3.50	9.75	9.69	61.60	5.53	29.0
....	....	**8.00**	.....	.....	**3.00**	....
9.07	3.07	9.38	7.22	67.96	3.30	28.0
....	....	**8.00**	.....	.....	**3.25**	....
10.08	2.94	8.88	10.01	64.45	3.64	30.0
....	....	**9.00**	.....	.....	**3.00**	....
9.25	3.57	9.63	9.49	61.81	6.25	30.0
....	....	**8.00**	.....	.....	**5.00**	...
11.19	2.18	11.13	4.53	67.08	3.89	32.0
9.02	2.33	10.94	5.43	68.23	4.05	30.0
10.10	**2.26**	**11.04**	**4.98**	**67.65**	**3.97**	**31.0**
10.20	4.48	10.88	14.15	57.00	3.29	25.0
....	....	**9.60**	.....	.....	**2.75**	....
10.15	4.09	10.75	15.28	56.52	3.21	24.0
....	....	**9.80**	.....	.....	**2.75**	....
10.17	**4.20**	**10.82**	**14.71**	**56.76**	**3.25**	**24.5**

TABLE V.—ANALYSES OF COMMERCIAL FEEDS

BRAND.	RETAIL DEALER.
MIXED FEEDS.—*Continued.*	
Proprietary Horse Feeds.	
Buf Ce Co. Horse Feed. Buffalo Cereal Co., Buffalo, N. Y.	*Shelton:* Ansonia Flour & Grain Co.
	Guaranty
Bonnie Horse Feed. Manuel T. Hatch, South Norwalk	*South Norwalk:*
	Guaranty
Algrane Horse Feed. H. O. Co., Buffalo, N. Y.	*E. Hartford:* W. K. Ackley
	Guaranty
Molasses Horse Feed. Husted Mills Co., Buffalo, N. Y.	*Colchester:* David Shea
	Guaranty
Schumacher's Special Horse Feed. Quaker Oats Co., Chicago	*New London:* P. Schwartz Co
	Guaranty
V-B. Horse Feed. Vincent Bros., Bridgeport	*Bridgeport:*
	Guaranty
Proprietary Dairy and Stock Feeds.	
Sucrene Dairy Feed. American Milling Co., Chicago	*Danbury:* F. C. Benjamin &
	Guaranty
Biles Ready Dairy Ration. The J. W. Biles Co., Cincinnati, O.	*Middletown:* Meech & Stodd
	Guaranty
Buf Ce Co. Creamery Feed. Buffalo Cereal Co., Buffalo, N. Y.	*Thomaston:* L. E. Blackmer
	Guaranty
Calf Meal. Blatchford's Calf Meal Factory, Waukegan, Ill.	*E. Hartford:* G. M. White &
	Guaranty
Unicorn Dairy Ration. Chapin & Co., Milwaukee, Wis.	*Wallingford:* E. E. Hall
Unicorn Dairy Ration. Chapin & Co., Milwaukee, Wis.	*Cheshire:* G. W. Thorpe
	Average guaranty
	Average of these 2 analyses
Wirthmore Balanced Ration. C. M. Cox Co., Boston	*Guilford:* Morse & Landon.
	Guaranty
Wirthmore Stock Feed. C. M. Cox Co., Boston	*Mystic:* Mystic Grain Co.
	Guaranty
Grandin's Stock Feed. D. H. Grandin Mill Co., Jamestown, N. Y.	*New Haven:* W. E. Crittend
	Guaranty
Henkel's Fine White Feed. Commercial Mill. Co., Detroit, Mich.	*Meriden:* Grain & Feed Co.
	Guaranty
Husted Molasses Feed. Husted Mill. Co., Buffalo, N. Y.	*Wallingford:* Gallagher Bros

SAMPLED IN 1912—*Continued.*

Pounds per Hundred. Water.	Ash.	Protein. (N x 6.25.)	Fiber.	Nitrogen-free Extract. (Starch, gum, etc.)	Ether Extract. (Fat.)	Price per ton.
9.60	3.39	11.56	9.07	62.41	3.97	$35.0
....	....	**10.00**	.....	.....	**4.00**	....
10.47	2.72	13.00	5.73	63.63	4.45	33.0
....	....	**14.00**	.....	.....	**4.00**	....
8.58	3.71	12.50	10.85	59.49	4.87	34.0
....	....	**11.00**	.....	.....	**4.00**	....
10.65	4.97	10.31	6.26	64.06	3.75	30.0
....	....	**7.00**	.....	.....	**3.00**	....
9.05	4.40	10.25	7.67	65.04	3.59	29.0
....	....	**9.25**	.....	.....	**3.25**	....
10.15	2.41	12.00	5.23	65.06	5.15	32.0
....	....	**9.40**	.....	.....	**3.40**	....
10.56	9.20	18.13	11.17	45.24	5.70	29.0
....	....	**16.50**	.....	.....	**3.00**	....
8.67	5.71	24.31	9.67	45.12	6.52	33.0
....	....	**24.00**	.....	.....	**7.00**	....
8.80	4.44	18.75	9.50	52.92	5.59	34.0
....	....	**18.00**	.....	.....	**4.00**	....
10.62	5.10	24.75	6.23	48.58	4.72	70.0
....	....	**25.00**	.....	.....	**5.00**	....
8.42	6.05	26.25	7.21	45.95	6.12	33.0
6.79	4.50	27.06	10.61	44.67	6.37	33.0
....	....	**20.00**	.....	.....	**5.50**	....
7.60	**5.27**	**26.66**	**8.91**	**45.31**	**6.25**	**33.0**
8.41	5.46	26.56	8.18	45.58	5.81	33.0
....	....	**25.50**	.....	.....	**5.20**	....
8.22	3.24	10.94	7.92	63.20	6.48	30.0
....	....	**9.00**	.....	.....	**4.00**	....
8.71	3.44	11.25	6.20	62.31	8.09	30.0
....	....	**8.50**	.....	.....	**3.50**	....
10.45	3.71	16.50	4.45	61.19	3.70	35.0
....	....	**15.00**	.....	.....	**3.50**	....
11.69	7.05	20.25	7.41	49.55	4.05	31.0

TABLE V.—ANALYSES OF COMMERCIAL FEEDS

BRAND.	RETAIL DEALER.
MIXED FEEDS.—*Continued.*	
Proprietary Dairy and Stock Feeds.	
Husted Steam Cooked Feed. Husted Mill. Co., Buffalo, N. Y.	*New Britain:* Stanley Svea (
	Guaranty
Zenith Stock Feed. Husted Mill. Co., Buffalo, N. Y.	*New Britain:* Stanley Svea (
	Guaranty
Larro Feed for Dairy Cows. Larrowe Mill. Co., Detroit, Mich.	*New Haven:* R. G. Davis & S
	Guaranty
Green Meadow Dairy Feed. Omaha Alfalfa Mill. Co., Omaha, Neb.	*Westerly:* C. W. Campbell C
	Guaranty
Blue Ribbon Dairy Feed. Quaker Oats Co., Chicago	*Thompsonville:* H. K. Braina
	Guaranty
Quaker Molasses Dairy Feed. Quaker Oats Co., Chicago	*Cheshire:* G. W. Thorpe
	Guaranty
Schumacher's Calf Meal. Quaker Oats Co., Chicago	*Norwalk:* Holmes, Keeler & Kent Co.
	Guaranty
Schumacher's Stock Feed. Quaker Oats Co., Chicago	*No. Haven:* Coöperative Feed
	Guaranty
Purina Molasses Feed. Ralston Purina Co., St. Louis	*New Haven:* J. T. Benham,
	Guaranty
Presto Molasses Feed. Scientific Feed Co., Milford	*Bridgeport:* Vincent Bros.
	Guaranty
V-B. Dairy Feed. Vincent Bros., Bridgeport	*Bridgeport:*
	Guaranty
Proprietary Poultry Feeds.	
American Poultry Feed. Quaker Oats Co., Chicago	*Meriden:* A. Grulich
	Guaranty
Buf Ce Co. Poultry Feed. Buffalo Cereal Co., Buffalo, N. Y.	*Torrington:* D. L. Talcott
	Guaranty
Wirthmore Poultry Mash. C. M. Cox Co., Boston	*Meriden:* Grain & Feed Co.
	Guaranty
Queen Poultry Mash. Albert Dickinson Co., Chicago	*Waterbury:* H. S. Coe & Co
	Guaranty
Red Comb Meal Mash. Edwards & Loomis, Chicago	*Hazardville:* A. D. Bridges Sons Co.
	Guaranty
Bonnie Poultry Feed. Manuel T. Hatch, So.	

SAMPLED IN 1912—*Continued.*

	Pounds per Hundred.						
	Water.	Ash.	Protein. (N x 6.25.)	Fiber.	Nitrogen-free Extract. (Starch, gum, etc.)	Ether Extract. (Fat.)	
11	10.33	2.28	10.63	5.48	66.51	4.77	$3
..	....	....	**9.00**	.....	.....	**4.00**	..
09	10.72	3.56	11.81	5.40	62.99	5.52	3
..	....	....	**10.00**	.....	.....	**4.00**	..
16	8.08	4.44	19.38	12.46	52.21	3.43	3
..	....	....	**19.00**	.....	.....	**3.00**	..
32	17.70	10.86	11.30	15.00	44.50	0.64	2
..	....	....	**11.00**	.....	.....	**1.00**	..
86	9.06	7.03	24.75	10.64	44.17	4.35	3
..	....	....	**25.00**	.....	.....	**4.00**	..
90	9.50	7.37	16.50	11.12	51.31	4.20	3
..	....	....	**16.00**	.....	.....	**3.50**	..
41	9.03	4.84	17.88	2.68	58.08	7.49	6
..	....	....	**19.00**	.....	.....	**8.00**	..
77	9.06	3.19	10.38	9.45	64.34	3.58	3
..	....	....	**10.00**	.....	.....	**3.25**	..
72	12.20	5.62	10.50	9.57	59.96	2.15	3
..	....	....	**10.00**	.....	.....	**2.50**	..
31	13.18	6.47	14.38	6.75	56.09	3.13	3
..	....	....	**14.00**	.....	.....	**3.40**	..
27	8.96	3.90	21.88	8.49	51.91	4.86	3
..	....	....	**20.00**	.....	.....	**4.00**	..
95	10.67	2.62	13.63	3.88	64.08	5.12	3
..	....	....	**12.00**	.....	.....	**3.50**	..
51	9.29	2.86	17.00	5.01	60.68	5.16	4
..	....	....	**15.00**	.....	.....	**4.00**	..
99	9.40	13.35	24.38	5.21	44.09	3.57	4
..	....	....	**17.00**	.....	.....	**4.00**	..
51	10.93	3.44	10.38	5.85	65.78	3.62	4
.	....	....	**11.00**	.....	.....	**2.50**	..
38	11.08	5.28	14.75	7.53	58.69	2.67	4
.	....	....	**15.00**	.....	.....	**4.00**	..
55	9.00	8.04	17.13	6.63	54.30	4.00	43

TABLE V.—ANALYSES OF COMMERCIAL FEEDS

BRAND.	RETAIL DEALER.
MIXED FEEDS.—*Concluded.*	
Proprietary Poultry Feeds.	
*Purity Poultry Mash. Wm. Hills & Co., Boston	*Bristol:* W. O. Goodsell...
H. O. Poultry Feed. H. O. Co., Buffalo, N. Y...	*New Britain:* C. W. Lines
	Guaranty..................
Husted Laying Mash. Husted Mills, Buffalo, N. Y.	*New Britain:* Stanley Svea
	Guaranty..................
Dry Mash Feed. Park & Pollard Co., Boston...	*E. Hartford:* G. M. White &
	Guaranty.... ....
Growing Feed. Park & Pollard Co., Boston.....	*Norwalk:* Holmes, Keeler & Kent Co. ....
	Guaranty..................
Chicken Chowder Feed. Purina Mills, St. Louis.	*New Haven:* J. T. Benham,
	Guaranty..................
V-B Growing Feed. Vincent Bros., Bridgeport..	*Bridgeport:* ....
V-B Mash for Laying Hens. Vincent Bros., Bridgeport..................................	*Greenwich:* J. P. Johnson ..
	Guaranty..................
Beef Scrap, Meat Meal and Fish Meal.	
Ground Beef Scrap. Joseph Breck & Sons, Boston	*Bridgeport:* Vincent Bros..
	Guaranty..................
Meat Meal for Poultry. Conn. Fat Rend. Co., New Haven..................................	*Guilford:* G. F. Walter.....
	Guaranty..................
Frisbie's Poultry Food. L. T. Frisbie Co., New Haven	*Guilford:* Morse & Landon.
	Guaranty..................
Fish Meal. Wm. S. Hills Co., Boston...........	*Danielson.* Young Bros. Co
	Guaranty..................
Pawtucket Poultry Food. Pawtucket Rend. Co., Pawtucket, R. I............................	*Westerly:* C. W. Campbell
	Guaranty..................
Poultry Meal. Ross Bros. Co., Worcester, Mass.	*Danielson:* Young Bros. Co
	Guaranty..................
Pure Ground Beef Scrap. C. M. Shay Fert. Co., Groton	*E. Hartford:* G. M. White &
	Guaranty..................
Ground Beef Scraps. M. L. Shoemaker Co., Philadelphia.................................	*E. Haven:* F. A. Forbes....
	Guaranty..................
Poultry Food. Springfield Rend. Co., Springfield, Mass.	*Thompsonville:* H. K. Brair
	Guaranty..................
Cooked Meat Scraps. Swift's Lowell Fert. Co., Boston	*So. Norwalk:* M. T. Hatch .
	Guaranty..................
Beef Scrap. Whitman & Pratt Rend. Co., Lowell, Mass.	*Bethel:* Johnston & Morriso
	Guaranty..................

Pounds per Hundred.						Price per ton.
Water.	Ash.	Protein. (N x 6.25.)	Fiber.	Nitrogen-free Extract. (Starch, gum, etc.)	Ether Extract. (Fat.)	
9.24	11.42	21.50	5.80	45.94	6.10	$42.00
9.70	3.84	18.44	6.02	56.63	5.37	38.00
....	....	**17.00**	.....	.....	**5.50**	.....
10.65	3.85	17.25	5.18	57.58	5.49	41.00
....	.....	**15.00**	.....	.....	**3.00**	.....
9.72	10.77	18.25	8.36	48.42	4.48	43.00
....	.....	**20.00**	.....	.....	**3.00**	.....
10.24	7.36	15.31	4.85	56.65	5.59	50.00
....	.....	**14.00**	.....	.....	**3.00**	.....
10.45	6.37	18.13	6.55	55.08	3.42	48.00
....	.....	**17.00**	.....	.....	**3.00**	.....
6.86	8.12	20.00	5.13	53.90	5.99	43.00
9.62	9.08	23.00	8.28	44.44	5.58	48.00
....	.....	**21.00**	.....	.....	**4.00**	.....
6.77	26.36	46.13	.....	.....	16.55	62.00
....	.....	**40.00**	.....	.....	**10.00**	.....
7.18	29.41	47.63	.....	.....	11.96	57.00
....	.....	**35.00**	.....	.....	**8.00**	.....
6.36	40.47	36.88	.....	.....	10.00	55.00
....	.....	**40.00**	.....	.....	**8.00**	.....
10.17	31.37	54.69	.....	.....	2.00	55.00
....	.....	**45.00**	.....	.....	**2.00**	.....
6.34	31.13	46.88	.....	.....	11.19	51.00
....	.....	**40.00**	.....	.....	**8.00**	.....
3.52	51.06	28.63	.....	.....	10.12	45.00
....	.....	**30.00**	.....	.....	**10.00**	.....
7.79	38.60	37.00	.....	.....	12.17	55.00
....	.....	**35.00**	.....	.....	**15.00**	.....
8.94	17.96	57.00	.....	.....	14.88	63.00
....	.....	**55.00**	.....	.....	**10.00**	.....
6.18	35.11	46.63	.....	.....	9.70	50.00
....	.....	**40.00**	.....	.....	**8.00**	.....
5.32	38.38	40.06	.....	.....	10.92	55.00
....	.....	**40.00**	.....	.....	**8.00**	.....
7.79	31.19	43.69	.....	.....	12.59	55.00
....	.....	**45.00**	.....	.....	**10.00**	.....
7.23	31.10	46.38	.....	.....	10.67	54.00
....	.....	**40.00**	.....	.....	**8.00**	.....

per ton for his feeds than he did in 1899, nine of the thirteen feeds showing an increase of 59 per cent. or over. In this era of high prices the financial success of the dairyman depends to a very great degree on the prices he is paying for his feeds. He buys, or should buy, most of his feeds for the protein they contain. The carbohydrate feed at $30 per ton is a luxury that few dairymen can afford. Probably the time will never come when the average feeder can raise on his farm all the feed required by his stock, but certainly intelligent management can greatly reduce the amount he need purchase. No feeder can afford to purchase under any circumstances, at the prices asked for them, corn cobs, oat hulls and weed seeds. Soaking weed seeds with molasses, or mixing a little cotton seed meal or gluten feed with oat hulls does not by any magic process endow these products with a nutritive value they never possessed and never can possess. The purchase of small amounts of high-grade feeds mixed with relatively worthless material under the guise of some wonderfully effective special mixture bearing a proprietary name is never economical. The feeder has plenty of roughage of this sort already at hand on his farm. With city feeders, who are obliged to buy all their feeds, these arguments of course have less weight, but even with these a considerable economy may be effected by a careful scrutiny of the guaranty, the ingredients used, the chemical analysis and the price asked.

Feed Definitions.

Following are the definitions of the various commercial feeds which have been formally adopted by the Association of Feed Control Officials of the United States:

Alfalfa meal is the entire alfalfa hay ground, and does not contain an admixture of ground alfalfa straw or other foreign materials.

Blood meal is ground dried blood.

Brewers' dried grains are the properly dried residue from cereals obtained in the manufacture of beer.

Buckwheat shorts or buckwheat middlings are that portion of the buckwheat grain immediately inside of the hull after separation from the flour.

Chop is a ground or chop feed composed of one or more different cereals or by-products thereof. If it bears a name descriptive of the

Clipped oat refuse (term oat clippings not recognized) is the resultant by-product obtained in the manufacture of clipped oats. It may contain light, chaffy material broken from the ends of the hulls, empty hulls, light, immature oats and dust. It must not contain an excessive amount of oat hulls.

Corn bran is the outer coating of the corn kernel.

Corn feed meal is the sifting obtained in the manufacture of cracked corn and table meal made from the whole grain.

Cornstarch by-product with corn bran is that portion of commercial shelled corn that remains after the separation of the larger part of the starch, and the germ by the processes employed in the manufacture of cornstarch and glucose. It may or may not contain corn solubles.

Cornstarch by-product without corn bran is that part of commercial shelled corn that remains after the separation of the larger part of the starch, the germ and the bran by the processes employed in the manufacture of cornstarch and glucose. It may or may not contain corn solubles.

Cottonseed meal is a product of the cottonseed only, composed principally of the kernel with such portion of the hull as is necessary in the manufacture of oil; provided that nothing shall be recognized as cottonseed meal that does not conform to the foregoing definition and that does not contain at least 36 per cent. of protein.

Choice cottonseed meal must be finely ground, not necessarily bolted, perfectly sound and sweet in odor, yellow, free from excess of lint, and must contain at least 41 per cent. of protein.

Prime cottonseed meal must be finely ground, not necessarily bolted, of sweet odor, reasonably bright in color, yellow, not brown or reddish, free from excess of lint, and must contain at least 38.6 per cent. protein.

Good cottonseed meal must be finely ground, not necessarily bolted, of sweet odor, reasonably bright in color and must contain at least 36 per cent. of protein.

Cottonseed feed is a mixture of cottonseed meal and cottonseed hulls, containing less than 36 per cent. of protein.

Cracklings are the residue after partially extracting the fats and oils from the animal tissue. If they bear a name descriptive of their kind, composition or origin, they must correspond thereto.

Digester tankage is the residue from animal tissue exclusive of hoof and horn specially prepared for feeding purposes by tanking under live steam, drying under high heat, and suitable grinding. If it contains any considerable amount of bone, it must be designated **digester meat and bone tankage.**

Distillers' dried grains are the dried residue from cereals obtained in the manufacture of alcohol and distilled liquors. The product shall bear the designation indicating the cereal predominating.

Flax plant by-product is that portion of the flax plant remaining

shives, and consists of flax shives, flax pods, broken and immature flax seeds and the corticle tissue of the stem.

Grits are the hard, flinty portions of Indian corn without hulls and germ.

Hominy meal, hominy feed, or hominy chop is a mixture of the bran coating, the germ and a part of the starchy portion of the corn kernel obtained in the manufacture of hominy grits for human consumption.

Malt sprouts are the sprouts of the barley grain. If the sprouts are derived from any other malted cereal, the source must be designated.

Meal is the clean, sound, ground product of the entire grain, cereal or seed which it purports to represent: Provided, that the following meals, qualified by their descriptive names, are to be known as, viz.: **Corn germ meal** is a product in the manufacture of starch, glucose and other corn products and is the germ layer from which a part of the corn oil has been extracted. **Linseed meal** is the ground residue after extraction of part of the oil from ground flaxseed.

Meat scrap and meat meal are the ground residues from animal tissue exclusive of hoof and bone. If they contain any considerable amount of bone, they must be designated **meat** and **bone scrap**, or **meat** and **bone meal**. If they bear a name descriptive of their kind, composition or origin, they must correspond thereto.

Oat groats are the kernels of the oat berry with the hulls removed.

Oat hulls are the outer chaffy coverings of the oat grain.

Oat middlings are the floury portion of the oat groat obtained in the milling of rolled oats.

Oat shorts are the covering of the oat grain lying immediately inside the hull, being a fuzzy material carrying with it considerable portions of the fine floury part of the groat obtained in the milling of rolled oats.

Red dog is a low grade wheat flour containing the finer particles of bran.

Rice bran is the cuticle beneath the hull.

Rice hulls are the outer chaffy coverings of the rice grain.

Rice polish is the finely powdered material obtained in polishing the kernel.

Screenings are the smaller imperfect grains, weed seeds and other foreign material having feeding value, separated in cleaning the grain.

Shipstuff or **wheat mixed feed** is a mixture of the products other than the flour obtained from the milling of the wheat berry.

Shorts or standard middlings are the fine particles of the outer and inner bran separated from bran and white middlings.

Wheat bran is the coarse outer coatings of the wheat berry.

Wheat white middlings or **white middlings** are that part of the offal of wheat intermediate between shorts or standard middlings and

PART V.

REPORT OF THE BOTANIST FOR 1911 AND 1912.

G. P. CLINTON.

I. NOTES ON PLANT DISEASES OF CONNECTICUT.

A. DISEASES PREVALENT IN 1911 AND 1912.

Weather Conditions in 1911. The winter of 1910-11 was rather open, with very little extremely cold weather. Snow was not abundant, and the little that fell did not cover the ground long. During January and February there were a number of rainy days. As this moist, warm weather was not followed by a sudden cold snap, comparatively little winter injury resulted.

There were two late frosts during the first week of May that injured some of the fruit blossoms, especially cherry and certain varieties of apple, also tomatoes that had been set out early, but on the whole the injury was not extensive. In case of the apples, the pistils were frequently the only part of the blossoms hurt. Some of the very young leaves were also injured, causing them to have a stunted appearance, with the epidermis loosened, in a wrinkled irregular fashion, from the apparently thickened tissues beneath. The spring, on the whole, was rather dry and warm.

June and July were extremely dry, with very hot periods in the latter month, causing an unusual scald of apples and, to a less extent, of peaches. Gooseberries were even baked on the bushes. This drought, perhaps the worst of those that have occurred during the last five years, was extremely hard on vegetation in general, and especially so on certain market garden crops and on trees that had suffered previously from drought and winter injury. Hail during the summer caused some damage to tobacco and apples in certain restricted localities. From the middle of August on, the moisture was sufficient for most

plants, though it could not overcome the previous ill effects of the drought on some crops. An early frost, coming about September 13, cut the season rather short, and caused considerable injury to corn and late tobacco.

Diseases Prevalent in 1911. On account of the comparatively dry spring and very dry early summer, fungous diseases were not prominent, especially those that get their start in the spring. Among the more prominent may be mentioned the following: Sun Scorch, Sooty Blotch and Speck Rots (due chiefly to Black Rot and Fruit Speck) of apple; Scab of beets, prominent in the vicinity of Norfolk; Leaf Spot of celery; Black Knot of cherry and plum; Bark Disease of chestnuts, especially bad, apparently because of drought injury to the trees; Anthracnose of cucumber and muskmelon, and also Leaf Mold of the latter host; Leaf Scorch of hemlock, etc.; Bacterial Blight of pear; Tip Burn of potatoes; Mildew of rose; Calico and Pole Burn of tobacco.

On the other hand, certain diseases were less conspicuous than usual, and in some cases not seen at all. Among these were: Rust and Scab of apple, less prominent than usual because of the comparatively dry spring; Rust of asparagus, not uncommon at the end of the season, but late in starting, and so not especially injurious; Anthracnose of string beans, apparently quite inconspicuous; Mildew of Lima beans, not found at all; Brown Rot, causing little injury to cherry and plum, and not so much as usual to peaches; Leaf Curl of peach, comparatively inconspicuous; Scab of pear, very much less than usual, even on susceptible varieties; Late Blight of potatoes, entirely absent except in the northwestern part of the State, where it caused a little rot of the tubers; Rust of quince, less prominent than usual.

Weather Conditions in 1912. The year 1912 presented weather conditions rather different from those of the preceding year. In the first place, the winter was unusually severe, some of the coldest weather for years being recorded during January. As this followed much warm weather in December, it killed a good many fruit buds, particularly peaches, so that this crop was quite light, especially inland. This cold also produced some injury to the wood of peach trees, but not nearly so much as in some of the preceding severe winters.

The spring was very wet in April and May, and as considerable

replenished the supply greatly depleted by the drought of 1911. This wet spring put back the earlier crops considerably, and late frosts about the middle of June added further to their troubles. These frosts injured garden crops considerably, and even killed the leaves of certain trees in the northern part of the State. The wet spring, however, favored forage crops as a whole.

June and July (to the middle), however, showed another long drought period, but this was not so hot as that of the preceding year, and because of the supply of water in the ground, the deep-rooted crops did not suffer much. From the middle of July on, while some localities suffered from lack of rain, most of them had enough scattered rains to mature the crops in good shape, except potatoes, and, in some cases, onions.

Another factor that made the season a favorable one for vegetation in general was the very late appearance of the fall frosts. While very slight frosts occurred the last of September and the first of October, these only partially killed the most tender plants, as melons, etc. The first heavy frost did not occur until November 2, thus giving in the end an unusually long growing season despite the late spring. On the whole, the season was much more favorable to vegetation than the preceding one. Peach trees showed the best foliage conditions for some years.

Diseases Prevalent in 1912. Fungous diseases were more prominent this year than the preceding, especially those that developed into prominence because of the wet spring. Among those occurring abundantly may be mentioned the following: Black Rot of apple, on the foliage, and Rust and Scab on the same host, especially the former, were abundant. The Cedar Apple, *Gynnosporangium macropus,* Plate XVIII c, which is the III stage from which the apple rust develops, was also unusually common in the spring, thus accounting for the abundance of the apple rust which followed later.

Rust of white ash, *Æcidium Fraxini,* was also very common, being sent in for identification from a number of localities, especially along the shore. It was prominent there because the III, or mature stage, of this rust occurs on marsh grass, Spartina sps., which is common along the shore. The appearance of the I stage on the ash is shown in Plate XVII a.

Orange Rust of blackberry, etc., was more common than usual, as was also the Anthracnose of cherry. Sun Scorch and Black Spot of maple were not uncommon. The Bark Disease of chestnut, on the other hand, seems to have been set back somewhat by the moisture conditions more favorable to its host, since a number of observers reported fewer infections, and old cankers with less vigorous development than in the preceding year. Bacterial Rot of cabbage did some damage in certain fields, and will be described later in this report. Anthracnose of currants caused considerable harm by premature defoliation.

Leaf Spots of horse-chestnut and Boston ivy were more conspicuous than usual. Leaf Mold of melons caused considerable injury, so that the sprayed vines did much better than those unsprayed. Leaf Curl of peach was more conspicuous by far than we have ever seen it, due to the favorable wet spring; and Scab was also conspicuous. Brown Rot, on the other hand, did comparatively little harm except to certain early varieties like the Champion. This was due in part to the light crop, and in part to the rather dry weather at harvest time. The Bacterial Blight of pear and quince and the Rust of the latter host were more prevalent than usual, though not very serious. Early Blight of potatoes developed somewhat, and there was considerable Tip Burn, but little or no Late Blight. There were a few complaints of Yellows of raspberry and Mildew of rose.

Beside the preceding, there were reported during the two years a number of new or unusual troubles which we shall describe more in detail under the following heads:

B. DISEASES OR HOSTS NOT PREVIOUSLY REPORTED.

APPLE, *Pyrus Malus.*

RUST, ORANGE, *Ræstelia aurantiaca* Pk. We have already reported two other species of rusts on the leaves and fruit of apple, but this is the first species we have seen occurring on the stems. This, however, is rather characteristic of the present species, as we have found it on other hosts, the quince and Cratægus, not uncommon on the twigs. It was sent to the Station from two different localities during the past season, but evidently is not very common on the apple, as we have never col-

the twigs, and in these the fragile, white peridia, or fruiting cups, develop, and upon opening disclose a mass of bright orange-colored spores that by their color and microscopic characters are easily distinguished from the other two species previously reported. One of the specimens sent in the late fall showed the young twig swollen and still alive, while the fruiting pustnles had not yet developed. This indicated that the twig might live over the winter and develop this stage the following spring. Ordinarily these swellings develop their fruiting bodies, and then are gradually killed by the fungus, so that the next season no further development occurs on them or on the uninjured portion of the twig below, thus showing that the fungus is not perennial on the host. The III, or Gymnosporangium, stage of the fungus occurs on both the red cedar and the common juniper in spring, and is spread from these to its alternate rosaceous hosts, among which, besides those already mentioned, is the Juneberry.

BANANA, *Musa sapientum.*

ANTHRACNOSE, *Glœosporium musarum* Cke. & Mass. This fungus is not uncommonly found on bananas in our markets. It causes a blackening and dry decay of the skin. Eventually the fruiting stage shows as small, pinkish, more or less numerous exudations. If kept in a moist chamber, these become much more prominent. Cultnres are easily obtained, and these produce only the conidial stage. As these cultures differ somewhat in appearance from those of the bitter rot of apple, and never with us have developed any asco-stage, we believe Shear is correct in considering it a distinct species. It is doubtful if *Myxosporium Musae* B. & C. (Grev. 3: 13), later issued by Ellis and Everhart (N. A. F. n. 2672) as *Glœosporium Musae*, is different, if we judge by the Ellis specimen, though the original description gives the spores as somewhat smaller than in the species under consideration here.

CABBAGE, *Brassica oleracea.*

BLACK BACTERIAL ROT, *Pseudomonas campestris* (Pamm.) Smith. Pl. XX a-b. This disease occurs on a number of related cruciferous plants, but we have reported it from this state before [illegible] did not see it on cabbage until

last season, it seems quite probable that it has caused more or less harm to this host before, since it has been reported as quite injurious in several other Eastern states in times past. The trouble was called to our attention last year by a request, late in September, from H. B. Cornwall of Meriden to visit his farm and see what was the matter with his cabbages. Inspection showed that the trouble, which was quite serious, was this bacterial disease. Although Mr. Cornwall had grown cabbage for some years, this was the first time that he had noticed trouble of this sort.

From what we could learn from Mr. Cornwall, the disease apparently started in his cabbage from the seed of Danish Bald Head, which was imported. This variety was by far the most infected, and in looking over the old seedbed, we found several stunted seedlings of this variety that showed the disease. Mr. Cornwall also gave some of the young plants to several of his neighbors, and an examination of their fields showed the disease on this variety, but not usually on the others.

Mr. Cornwall did not notice the trouble until about the middle of September, when, following a spell of muggy weather, this variety began to go down rapidly. Several other varieties, such as Copenhagen Market, Flat Dutch, and Savoy, showed little or none of the disease, although close to the Danish Bald Head. This probably means that the disease was not present in their seedlings, and that it spread to them later from the infected Danish Bald Head when the latter became badly infected. But of course it might also mean that these varieties were not so susceptible to the disease. The cabbage was on new land, and the plants were all from new seed beds. Part of the land had manure on it, and part had not, but this did not seem to make any difference. The Danish Bald Head first set out showed the trouble worse than those planted later.

This disease is recognized by the blackened veins of the leaves, Plate XX b, where the bacteria develop chiefly, and in time extend down into the head. The leaf tissues finally turn yellow, and the leaves are easily pulled off. Soft rot, caused in part by other organisms, often loosens them at the base, and develops an ill-smelling internal decay, XX a. The bacteria gain entrance through drops of water at the water pores on the margins of the

As the germs of this disease can be carried on the seed, as determined by Harding and Stewart, it is wise to see that the seed used does not come from a diseased crop. If doubt exists, it is well to treat the seed with formalin, 1-240, or corrosive sublimate, 1-1000, for fifteen minutes, as recommended by the investigators just mentioned. Likewise, if the disease shows up in a seedbed, this should be changed the next year. If bad in the field, this land should not be used for cruciferous crops for several seasons, and even if the disease is not present, yearly rotation is desirable where it can be carried on without especial difficulty. Refuse from diseased cabbages should never find its way to the manure pile.

CURRANT, BLACK, *Ribes nigrum.*

Pine-Currant Rust, *Cronartium ribicola* Waldh. Plate XVII b-c. In our last report, 1909-10, p. 730, we noted the finding of a few specimens of the peridial stage of this fungus, known as *Peridermium Strobi* Kleb., on recently imported white pine seedlings in several plantations in the state. These pines all came from one firm in Germany. In April, 1912, Mr. Walden, while inspecting imported nursery stock in one of the nurseries of the state, found in a shipment of three-year-old white pine seedlings, purchased from Schaum and Van Tol of Oudenbosch, Holland, at least 185 that showed the characteristic swellings or fruiting stage of this blister rust (see illustrations). The whole shipment was destroyed in consequence of this finding. Since then the United States Government has placed a quarantine on the importation of white pines into this country from any of the European countries where this disease is known to exist. Since our inspection of the plantations previously mentioned, no other examples of this rust have come to our attention, and, so far as we know, it does not exist to-day in this state.

The II and III stages of this rust occur on species of the genus Ribes, which includes our currants and gooseberries. Although occasional outbreaks of the rust on currant had been reported at Geneva, N. Y., we had never found it in this state. In 1912 Stewart, of the Geneva, N. Y., Station, reported another ... of the Amherst Station, foun

the disease in Massachusetts. The black currant seems to be by far the most susceptible of any of the varieties to this disease. On learning of the outbreak at Geneva, we kept watch for this rust in Connecticut, and early in October received leaves of black currants from H. B. Birdsey of Meriden which showed the III stage of the fungus. These currants, originally obtained from outside the state, had been planted in his garden about eight years, but he had not noticed this trouble before, though it may have escaped his attention. This year he noticed it because of the premature defoliation of the currants.

After locating this rust at Meriden, we visited several nurseries, and inspected their currants to see if it occurred there. We also wrote to all the nurseries in the state handling black currants, and requested them to look for the disease on the fallen leaves, as it was then late in the season, and to send us any suspicious ones. We were not able, however, to locate the rust in any of these nurseries. As black currants are not handled to any extent by our nurserymen, it is not likely that the disease occurs with them.

There are no white pines in the immediate vicinity of the rusted currants in Meriden, and Stewart has never found the peridial stage on the white pine at Geneva. This makes it look as if the rust might carry over on the currants in some way without the aid of this stage for reïnfection in the spring. In connection with Stewart and Stone, we have started, in the greenhouse, black currants that were last year badly infected, to see if the rust will again appear on them without the aid of the peridial stage. These plants were brought into the greenhouse in February, 1913, and at this writing, April 15th, although in full leaf, they had as yet shown no signs of the rust. From this it appears as if the fungus did not (at least commonly) carry over on the currants. Possibly we have not learned all about the life history of this fungus.

EVERGREENS, *Various Species.*

DAMPENING-OFF, *Rhizoctonia* sp. During the past year complaints were received of dampening-off in coniferous seed-beds. At the Station trouble of this kind was also noticed,

off at the surface, showed no conspicuous growth of any fungus, but upon microscopic examination, especially after keeping the plants in a moist chamber, the characteristic mycelium of this fungus could be found in more or less abundance. Cultures were readily obtained, and while these looked very similar to those of the potato Rhizoctonia, we are not sure whether they are identical. It seems, however, to be the same thing that causes dampening-off of a variety of plants in seed-beds and greenhouses.

This same fungus was also found dampening off coniferous seedlings in the Elm City Nursery, especially those of the yew, *Taxus cuspidata*. Those in charge stated that it was almost impossible to grow seedlings of this species, as it seems to be particularly subject to this injury. They found that if, as soon as the trouble appeared, they sprayed the ground around the affected plants with Bordeaux mixture, and repeated the spraying when necessary, they could save a fair percentage of the seedlings.

Sun Scorch. This may perhaps be considered a combination of winter injury and sun scorch. Various evergreens, especially hemlock, suffered severely from this widespread trouble in the early spring of 1911. While in most cases merely the leaves were killed in greater or less numbers, yet when this injury was severe enough the plants themselves died as a result of the severe defoliation that followed. Often only the outer ends of the leaves were killed, turning a reddish-brown in contrast with the green of the uninjured portion.

The trouble was probably due to unusually warm weather in March and April, starting evaporation from the leaves while the roots were still frozen in the ground and unable to readily replace this loss. Possibly part of the trouble may have been caused by the warm, moist weather in January and February and the subsequent colder weather. Plants recently re-planted suffered more than those well rooted.

HOPS, *Humulus japonicus.*

POWDERY MILDEW, *Sphærotheca Humuli* (DC.) Burr. This fungus forms a whitish, powdery growth on the leaves and stems [illegible] fruiting stage showing as very small blackish

found rather conspicuously in the fall on the variegated variety of the Japanese hop, cultivated for ornament in the writer's yard, and caused premature death of the foliage. While this mildew has been responsible for considerable damage in the hop districts of Europe in times past, it has only recently been complained of in the hop districts of New York State. Blodgett reports that dusting the plants with sulphur is a rather satisfactory method of controlling the trouble there.

JUNIPER, CHINESE, *Juniperus chinensis.*

RUST, *Gymnosporangium japonicum* Syd. Plate XVIII d. The last of March, 1911, Mr. Walden, while inspecting importations from Japan at the Elm City Nursery, found on the above host, specially on the form known as *compacta,* an unusual rust on both stems and leaves. On a seedling of this same species, called *J. virginalis,* this same rust was also found, but only on the leaves. Altogether, 55 plants were found that had the outbreaks on the stems, and these were all destroyed. Those showing the rust only on the leaves were ordered planted in an isolated place, and an examination of them the next spring revealed no signs of the fungus. A few days after Mr. Walden found these infected specimens, he discovered others in an importation, also from Japan, of the Stephen Hoyt's Sons Nursery Company. In this case 49 plants showing the rust on the stems were destroyed. The writer determined both these collections to be the telial, or III, stage of *Gymnosporangium japonicum* Syd., which until this time had not been reported in America.

An examination of Plate XVIII c-d shows that this rust is quite different from our common red cedar rust, though apparently it is not so different from some of the other species reported from this country, especially *G. effusum.* This fungus has been well described by Shirai in Zeitschr. für Pflanzenk. 10, pp. 1-5, and he determined that the I stage is *Ræstelia koreænsis,* which is more or less injurious to the foliage of pears; and can also infect apples and quinces, in Japan.

The gelatinous swellings of the fungus evidently developed on the infected trees in transit, though they appear in Japan a little earlier than in this country. These are the fruiting

or tongue-shaped, and run together on the stems, as shown in the illustration. On the leaves they are smaller, more isolated, more nearly conical, with one to three on a leaf. An examination of the sori showed that they contained two types of spores,—one type long, pointed, thin-walled, chiefly in the interior of the sorus, and the other smaller, thicker-walled, with round apices, less abundant, and chiefly on the exterior. Those on the leaves are as a rule smaller than those on the stem. Shirai found that insects, especially bees, were important factors in carrying the sporidia of the germinating teleutospores in these sori to the alternate rosaceous hosts.

This rust is probably perennial in the stems of the juniper, or else it takes two years for the sori to develop after infection. A juniper, which was badly rusted at the time of their discovery, was potted and placed in our greenhouse, where it has remained for two years. After the disappearance of the sori in the spring, the plant showed no signs of the rust that year or the next, but the spring following it again broke out in a different part of the stem, but not so conspicuously. Just how serious this rust might prove in its I stage on our pomaceous fruits, if it got started here, we do not know, but they certainly already have enough similar troubles.

KAFFIR CORN, *Sorghum vulgare* var.

Grain Smut, *Sphacelotheca Sorghi* (Lk.) Clint. We have reported this smut before on sorghum and broom corn. In September, 1911, we found it not only on these hosts, but also on Red Kaffir corn grown at the Experiment Station farm for experimental purposes. None of these hosts are of commercial importance in this state, so the smut is not of economic importance here, though often serious elsewhere. It changes the seeds into kernels filled with a dusty mass of brownish-black spores.

PEACH, *Prunus Persica*.

Stem Canker, *Phoma Persicæ* Sacc. This fungus has been reported previously in this country by Selby of Ohio (Ohio Exp. Stat. Bull. 92: 233. 1898. *Ibid.* 214: 423. 1910), who called it Constriction Disease of Stem, or Stem Blight. He reported i[illegible] [illegible] injury in one lot of heeled-in nursery stock

and he also found occasional specimens in orchards. Selby has not since found that this was a serious trouble in his state, and apparently the pruning off of the diseased branches is the only treatment necessary. From what we have seen of it in Connecticut we do not consider it a disease likely to prove troublesome here. Apparently it develops best on trees in a weakened condition.

It was first found in Connecticut in October, 1911, by Dr. Britton, while inspecting one-year-old seedlings in one of the nurseries, and later the same nursery company sent the writer specimens, writing as follows: "We are sending you under separate cover some samples of peach twigs. These were sent us by a customer of ours in New York State. We think he planted these trees last spring, and he says that he has quite a few where the wood is black in the center and the foliage is turning yellow and the edges of the leaves have been looking bad since July 15th."

An examination of both sets of specimens showed the fruiting stage of the Phoma fungus present. The twigs were partially or completely encircled by a depressed band of dead bark of varying width. This injury does not immediately kill the parts above, as the wood there often forms a greater growth than that below the cankers, giving rise to a slight swelling, though eventually the parts above are killed. The leaves turn yellow, and finally drop off. Cutting through the wood, we found a dark streak next the cambium, below the canker, but above it this was covered by the subsequent growth of the wood which formed the swelling. The stems were brittle and easily broken off at these areas. The fruiting pustules of the fungus show as small, more or less abundant, black specks. From these there ooze out the hyaline, oblong to broadly oval spores, which are round at the ends, sometimes slightly curved, and 7-10 μ long by 3-3.5 μ wide.

PINES, *Pinus* sps.

PINE-? SOLIDAGO RUST, *Peridermium delicatulum* A. & K. Plate XVIII a-b. Late in June, 1912, while examining the leaves of *Pinus rigida* at Granby for *Peridermium acicolum,* we not only found specimens of that rust, but also ran across specimens of

ferent and had never been collected before in the state. This rust we determined to be *Peridermium delicatulum*, and Kern, to whom we sent specimens, verified our determination, and kindly sent specimens of the type for comparison. This rust was originally described in 1906 by Arthur and Kern (Bull. Torr. Bot. Club 33:412) from Florida on leaves of Pinus sp., and apparently had not been collected since.

The illustration shows very well some of the macroscopic differences between this species and our more common *Peridermium acicolum*. These differences are as follows: (1) The peridia of *P. delicatulum* are very inconspicuous, being deeply embedded in, and standing very slightly above, the leaf tissues, and open by a long slit; while those of *P. acicolum* stand up prominently, 1-3 mm. above the surface of the leaf, and frequently remain as white, tongue-shaped elevations after the spores are shed. (2) The fresh spore-masses of the first species are less dusty, and are crimson, as compared with the orange-colored sori of the other species. (3) Microscopically the spores are smaller (18-29μ x 17-21μ, subspherical or cuboidal to ovoid), and with minute verruculations, while the spores of *P. acicolum* are covered with coarse, scale-like tubercles.

From observations made at the time, though not proved by inoculation experiments, it seems very probable that *P. delicatulum* has, like *P. acicolum*, its III stage as a Coleosporium on Solidago. Immediately under and close to the branch of *Pinus rigida* bearing the *P. delicatulum* was found a specimen of *Solidago graminifolia* var. *Nuttallii* containing the II stage of an undetermined Coleosporium. The spores of this were very similar in color and in fine verruculations to those of *Peridermium delicatulum* on the pine, just as are those of the II stage of *Coleosporium Solidaginis* on *Solidago rugosa* similar in color and coarse tubercles to those of its peridial stage, *P. acicolum*. We have reported before that the spores of all the specimens on Solidago, etc., of the II stage of so-called *Coleosporium Solidaginis* were not alike, and an examination of specimens on *Solidago graminifolia* var. *Nuttallii* already in the herbarium showed that these had the fine verruculations of this new species. It is hoped that we shall be able later by inoculation experiments to fully determine this species on the goldenrod and connect it with the

PINE-SWEET FERN RUST, *Peridermium pyriforme* Pk. We have already reported this fungus (which has its II and III stages on sweet fern, known as *Cronartium Comptoniae* Arth.) on *Pinus sylvestris, P. rigida, P. austriaca,* and *P. maritima,* from the Station forestry plantation at Rainbow. In May, 1911, Forester Spring found it there on *P. ponderosa,* and in May, 1912, Forester Filley and the writer found it on this host and *P. montana,* both hosts new, at least to this state. This makes six different species of pine on which we have now found this Peridermium.

STEM CANKER, ? *Phoma* sp. Plate XIX a. Several times we have had young specimens of white pine brought to us by foresters showing the base encircled by a dead sunken area, as shown in the illustration. Occasionally we have found the Phoma fruiting slightly on these dead areas, and at least in one case, we obtained this fungus in cultures from the specimens. We are not sure as yet whether this fungus is responsible for the trouble or whether it merely follows winter and drought injury. Some of the specimens have the aspect of being quite parasitic.

We have seen no notice of a Phoma canker of white pine in this country, but Tubeuf, in his Diseases of Plants, mentions two species of Phoma in Europe that attack the branches of various coniferous plants. One of these is *Phoma pithya* Sacc., and Saccardo, in his Host Index, gives the white pine as one of the hosts of this fungus. On the leaves of certain species of pine, including *Pinus montana,* we have seen *Phoma acicola* (Lev.) Sacc. It is a question with this species also whether it is parasitic or is merely following other injury where the leaves have been killed part way from the apex inward.

QUINCE, *Cydonia* sps.

FRUIT SPOT, *Cylindrosporium Pomi* Brooks. In our 1909-10 Report, page 723, we described the appearance of this fungus on the apple, and also reported finding it rarely on the common quince, *Cydonia vulgaris.* In October, 1912, the writer also found it on fruit of the Japan quince, *Cydonia japonica.* While the fruit of this was abundantly covered with small purplish discolorations, none of these showed the fruiting stage of the

were caused by this fungus. Of course the fruit of this ornamental plant is of no economic importance.

ROSE, *Rosa* sp.

CROWN GALL, *Bacterium tumefaciens* Sm. & Towns. Plate XIX b. We have reported previously this bacterial disease on the following hosts: apple, bittersweet (Japanese), blackberry, peach, plum, and raspberry. Besides these, we have reported a somewhat similar trouble on the branches of oak trees, and a trouble of grapes which we have considered a winter injury, but which some others attribute to the crown gall organism. While the rose has been reported elsewhere as a host, it had not been found infected in Connecticut until Walden, in December, 1911, while inspecting Manetti stock recently imported from England by A. N. Pierson of Cromwell, discovered a few plants showing the galls conspicuously on the roots. Specimens of these have been planted in our greenhouse for over a year, and the disease does not seem to have as yet very seriously affected the plants, or to have spread to any extent to the new roots.

TURNIP, SWEDE, *Brassica campestris.*

PHOMA ROT, *Phoma Napobrassicæ* Rost. Plate XX c-d. Ir December, 1912, Mr. W. N. Durgy of Danbury noticed a ro trouble in his Swede turnips, and later sent specimens to the Sta tion for information. Concerning this he wrote: "As I hav a trouble with my Rock turnips this year that I never had befor I thought I would send you a sample. They were nice and scli when I put them in the cellar, and now nearly half of them ar like the sample. Will you kindly report what is the cause o the trouble." Later, in answer to inquiries, he furnished the fo lowing information: "The turnips did not show any spots whe they were dug. The only thing we saw when we dug them w a decay on a very few around the top, so that when we pull them, the top would come off, but I thought nothing of thi I have not heard of any similar trouble around here. I ha made a specialty of raising turnips for a good many years, a have always stored them in the same place, i. e., the cellar botto My cellar is warm, but not very damp. I have had the far

before on the same ground, which was in 1911, but I manured it heavily with horse and cow manure, and used fertilizer besides."

An examination of the turnips sent showed that they had a dry rot, appearing as sunken, subcircular areas scattered over the roots, especially above, as in illustration c. These areas usually had a darker border, but on the samples we received we did not notice that this was purplish or that the spots were finally cracked, as described for the trouble on Swedish turnips elsewhere. A microscopic examination showed the mycelium of the fungus abundant in these spots, and apparently the cause of the decay. No fruiting bodies showed, but after placing the turnip for a few days in a moist chamber, these became abundant, as shown in illustration d. Cultures of the fungus were easily obtained, and these produced a black growth in the medium with a scanty, superficial, whitish or slightly pinkish tinted growth above. The spores exuded more or less abundantly in rose-colored, viscid masses. Mr. Stoddard readily produced the disease in healthy tubers, kept fairly moist and warm, on inoculation with spores from the cultures.

The writer is indebted to Stewart of Geneva, N. Y., for several references to this disease in other countries, but neither Stewart, Selby, nor anyone else apparently, has reported a similar trouble in the United States. So far as the writer can judge from the meager description, our disease appears to be the same as that reported by Rostrup (5-6) from Denmark in 1893. He found it on Swede turnips, and describes as its cause a new fungus which he called *Phoma Napobrassicæ*. The trouble was next reported from the north of England, by Potter (4), who first noticed it in the winter of 1896-7. He also found it on the roots in the field. Potter merely identified the disease as caused by a species of Phoma, though he noted the possibility of its being the same species described by Rostrup. Carruthers (1) also reported this trouble from Lincolnshire, England, in 1903, and he had no doubt but that the disease reported by Potter and himself was the same as that described by Rostrup.

In 1905, Kirk (3) reported the disease from New Zealand as new in that region. He gives the following description of the injury: "Below the crown, and forming a kind of irregular

less circular depressed areas of decaying tissue, varying considerably in size. They are light brown and corky, and are generally surrounded by a well-defined purple margin. As the disease advances, these patches crack and form deep fissures, which spread deeply into the interior of the turnip, ruining it. Numerous black dots (pycnidia) now appear on the diseased patches; these dots are cone-shaped, and contain immense numbers of minute spores, which emerge from the apices of the fructification in small, globular, rose-colored masses. The spores then soon separate, and are disseminated by various agencies, especially wind."

In 1912, Güssow (2) reported the disease from Prince Edward Island, Canada, and this seems to be the first report of the disease from North America. While we have accepted Rostrup's name for the fungus, we are not sure whether it is distinct from a cabbage fungus (*Phoma Brassicæ*, or *P. oleracea*) that has caused more or less damage in Europe and was reported in 1911 by Manns (Ohio Agr. Exp. Stat. Bull. 228: 276-89) as causing serious injury in Ohio, especially through cankers on the stems. The cabbage and turnip both belong to the same genus, and so are closely related, and the Phoma fungi found on each cause cankers, and have spores about the same size. (Manns reports the spores of the cabbage Phoma as $4.5\text{-}5\mu$ x $1.7\text{-}2\mu$, while those of our turnip Phoma are chiefly $3.6\text{-}4.5\mu$ x 1.8μ). But we do not know whether the spore masses of the cabbage Phoma are rose-colored, as are those of the turnip Phoma. Manns reports the fungus as occurring on the leaves somewhat, and McAlpine reports it on the leaves of cabbage, turnip and rape. Johnson has reported a Phoma disease on the leaves of Swede turnip in Ireland, and this may be the same as our Phoma. The other writers do not distinctly mention the Phoma as occurring on the leaves of turnips, though from the spraying treatment recommended, it is at least suggested that it may occur there.

While the different investigators have suggested various preventive treatments, it is not known yet whether all of these are practical, especially the spraying of the foliage in the field. Certainly, however, rotation should be practiced where the disease has appeared in a field. It is also quite likely that the kind

This is especially true if diseased turnips have been fed to the stock. Storage in a dry, cool place, with piles not too large, may also help to keep down the trouble. No doubt the character of the season is a factor in the development of the disease.

1. **Carruthers, W.** Diseases of the turnip bulb. Journ. Roy. Agr. Soc. Eng. **64**: 297-300. 1903. [Illust.]

2. **Güssow, H. T.** Phoma rot of turnip. Exp. Farms Ottawa Rept. **1912**: 202-4. 1912.

3. **Kirk, T. W.** Diseases of Swede turnip. New Zealand Dept. Agr. Div. Biol. Hort. Bull. 14: 1-4. 1905. [Illust.]

4. **Potter, M. C.** A new Phoma disease of the Swede. Journ. Bd. Agr. **6**: (1-11 Reprint). [Illust.]

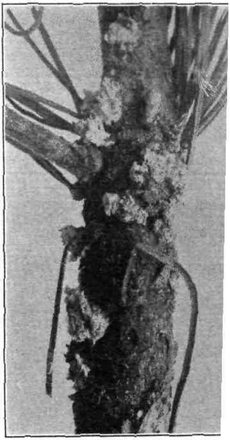
5. **Rostrup, E.** Oversigt over Sygdomme hos Kulturplanter. Tidsskr. Landökonom. **11**: 330. 1893.

6. **Rostrup, E.** Phoma-Angriff bei Wurzelgewächsen. Zeitschr. Pflanzenkr. **4**: 322-3. 1894.

WISTARIA, CHINESE, *Wistaria chinensis.*

CROWN GALL, *Bacterium tumefaciens* Sm. & Towns. Although we do not find the above host among those mentioned by Smith as infected by the crown gall, yet so far as one can judge from macroscopic examination, it is occasionally infected in this state. Mr. Walden collected specimens in March, 1912, on plants imported from Japan in one of the nurseries, and Dr. Britton later brought us specimens from a plant grown in his yard. In the latter case the galls were associated with an elongated, sunken area of dead bark, and on this we found the fruiting pustules of a fungus that agrees fairly well with *Phoma seposita* Sacc. Whether the latter was present as a saprophyte or a parasite was not determined, but probably it was the former, since we have seen no references to it as causing injury.

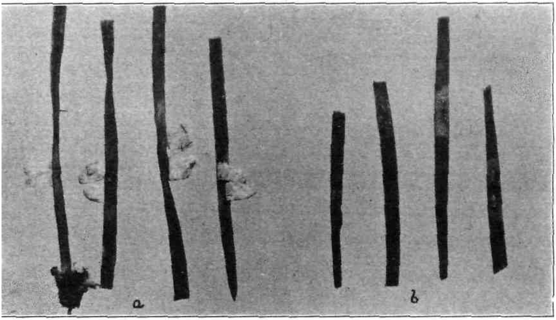
a. Ash Rust, p. 343.



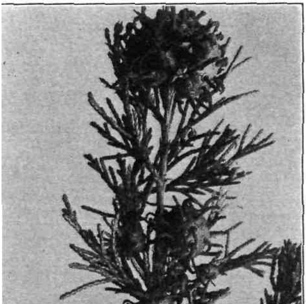
b. White Pine Rust, x 2, p. 3

c. White Pine Rust, nat. size, p. 347.

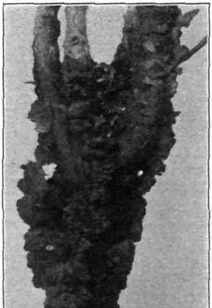
SOME TREE RUSTS.



a–b. Two species of Pine leaf Rusts, x 2–3, p. 352.



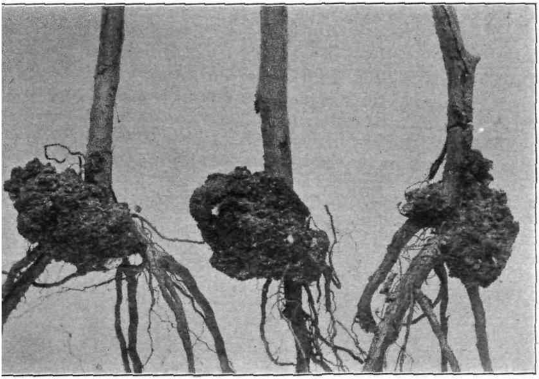
c. Common Cedar Rust, p. 343.



d. Japanese Juniper Rust, p. 350

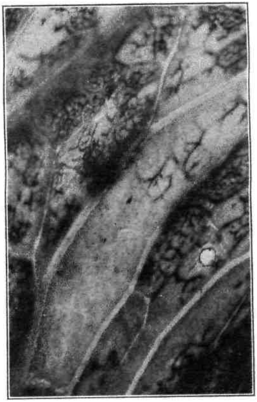
SOME TREE RUSTS.

a. Canker of White Pine, p. 354.



b. Crown Gall on Roses, p. 355.

DISEASES OF WHITE PINE AND ROSE.



a–b. Black Bacterial Rot of Cabbage, b. Showing blackened veins, p. 345.

c–d. Phoma Rot of Swede Turnip, d, x 2, with fruiting pustules, p. 355.

DISEASES OF CABBAGE AND TURNIP.

CHESTNUT BARK DISEASE,

Endothia gyrosa var. *parasitica* (Murr.) Clint.

HISTORICAL CONSIDERATION.

Introduction. It is now over eight years since the chestnut blight was first found in New York, and nearly six years since it was reported to this Station as occurring in Connecticut. The writer became acquainted with the trouble in 1905 through Murrill's work and specimens sent by him, and has been actively engaged in a special study of it ever since its discovery in Connecticut. Articles (5-12) concerning these studies have appeared from time to time in the Station Reports and elsewhere. Since our views have been, in part, at variance with those held by certain other investigators, we propose to give here more in detail the information we have gained during these investigations, and our conclusions therefrom.

We wish to acknowledge especial indebtedness to our assistant, Mr. Stoddard, who during the last three years has greatly aided in the work with artificial cultures, inoculation experiments, etc. Mr. Spring, the former, and Mr. Filley, the present, forester of this Station, have coöperated with the botanical department in determining the conditions in our forests and the possible remedial treatments. American and European botanists have aided with specimens and information; and we are especially indebted to Professor Farlow, of Harvard, in our systematic study of the blight fungus and its allies. We are also indebted to numerous persons interested in forestry in Connecticut for much local information.

Discovery of Disease. The chestnut blight was first noticed by H. W. Merkel, in charge of the trees of the New York Zoological Park, in the summer of 1904, as injuring scattered trees in that park. In 1905 it was so bad that he took active measures to bring it under control, and published (32) the first general description of the trouble in the Report of the New York Zoological Society for that year. The attention of Murrill, of the New York Botanical Garden, was called to the disease, which had now become quite conspicuous in the parks and woods in the vicinity of New York City, and he began a botanical study of it to determine the exact cause.

After a preliminary paper in the Journal of the New York Botanical Garden (45), published in June, 1906, he described in Torreya (47), in September of the same year, the specific fungus responsible for the trouble, a species new to science which he called *Diaporthe parasitica*.

Previous to this outbreak there is no record, so far as the writer knows, of a disease of chestnuts in this country, or elsewhere, that can be surely attributed to the same cause, though there have been troubles of chestnuts in the Southern States that may or may not have been due to it. These will be discussed more fully later. Since the disease has been called to the attention of the public, however, there are a number of persons who have reported that they believe that they have seen this or a very similar trouble previous to 1904.

For example, Metcalf and Collins (36, p. 45) say: "No earlier observation than this is recorded, but it is evident that the disease, which would of necessity have made slow advance at first, must have been in this general locality for a number of years in order to have gained such a foothold by 1904." And further on (p. 46) they add: "Observations by the junior writer indicate that this disease may have been present in an orchard in Bedford County, Va., as early as 1903, and that in Lancaster County, Pa., it was probably present as early as 1905."

Dr. Britton of this Station informs the writer that as far back as 1889 he knew of a seedling chestnut tree on a farm near Keene, N. H., that suddenly, during the summer, developed a progressive canker trouble that now seems to him to have been the chestnut blight.

Professor Davis, in the discussion at the Pennsylvania Chestnut Blight Conference at Harrisburg (54, p. 102), said: "I will say that I think I saw the blight on Long Island in 1897 or 1898. * * * That was in Cold Spring Harbor, in Huntington, especially back of Huntington, through the hills around there. So I think it was in 1898 well established in those localities." Mr. Child, of Putnam, Conn., at this same conference (54, p. 107) also said: "I know two men about sixty years of age who state that they are positive that they saw this blight twenty years ago, or something that looked the same as is shown in the blight to-day."

Early Investigations. We are indebted largely to Murrill (45-51) for our knowledge of the life history of the chestnut blight fungus. He not only gave a careful scientific description of its different spore stages, but by inoculation experiments proved that it could produce the disease in healthy seedlings. He also tried various methods of control.

The United States Department of Agriculture soon became interested in the disease, and through the efforts of Metcalf (33-39) and later of Collins (13-16) and others, facts concerning the distribution, hosts, and control of the fungus were made known. Metcalf (33) was the first to note the relative immunity of the Japanese varieties to the disease, and to suggest that the fungus was originally brought into this country from Japan. He is also, more than anyone else, to be credited for what good, if any, may arise from the attempted control of the fungus by the cutting-out quarantine method, since it is through his advocacy that this method has been undertaken in Pennsylvania and perhaps elsewhere.

The writer apparently was the next after Murrill and Metcalf to take up the special study of the disease. He was the first to try to prove that weather had some connection with the trouble, and through his investigations, in connection with Farlow, to show the relationship of the fungus to two other species found in this country, all of which are now considered species of the genus Endothia.

Recent Investigations. With the spread of the blight to new localities, and the appropriation of large sums of money by the National Government and the State of Pennsylvania for its special study and control, popular and scientific interest in this disease was greatly augmented. The more recent investigations have had to do largely with the detailed study of field conditions in the different states, especially in the State of Pennsylvania, where the force of scientific and general workers is larger than on any other special botanical investigation ever carried on in this country. This control work has been largely devised by Foresters Williams and Detwiler (19, p. 129), based on the cutting-out experiments of Metcalf at Washington (38). Recently Carleton, of the United States Department of Agriculture, has been given general control of all the work in

Pennsylvania, with Heald, formerly of Texas, in charge of the laboratory investigations.

Collins (16) has contributed to our knowledge of the treatment of individual trees. Rankin (59, 60), of New York, has reported on results of inoculation tests as to time of year, water content of trees, etc. Fulton (24), of Pennsylvania, has made a variety of field observations as to distribution of spores, conditions of infection, etc. The Andersons (1, 2) have reported on the character of the fungus in cultures, inoculation tests, etc. Craighead (17) and others have studied its relation to insects. Miss Rumbold (62, 63) has experimented with chemicals to determine their effect on the trees as regards blight resistance, etc.

Farlow (20, 21), Shear (64, 65), the Andersons (1, 2) and the writer (8-10) have studied the nomenclature and systematic relationships of the fungus. Stewart (70), Murrill (51, p. 194) and the writer have regarded unfavorably extensive control by cutting-out methods. Mickleborough (40, 41), Smith (67, 68) and others have contributed articles of interest to the general public. In Europe, von Höhnel (29), Rehm (61), and Pantanelli (52, 53) have published notes or papers on the subject.

Identity. In the study of a disease it is always very desirable to know exactly the fungus that causes it. While Murrill proved conclusively that his *Diaporthe parasitica* was the immediate cause of the chestnut blight, this did not necessarily prove, as he claimed, that it was a species new to science. The question naturally arises, has this fungus been previously known under some other name? As a vigorous parasite, killing off chestnut trees, there is certainly no record of any fungus that can be definitely identified with it. The writer from the first was skeptical about the fungus having entirely escaped previous observation by botanists, especially if it might under certain conditions exist as a weak parasite or a saprophyte. One of the first things we set about to learn, therefore, was whether or not this fungus had had a previous botanical record.

Schweinitz, a Bavarian minister, who lived at Salem, N. C., and Bethlehem, Pa., and made his botanical studies from about 1812 to 1834, was one of the first and most extensive collectors of fungi in this country. He described many species

new to science. It was among the species described by him, since the relationships of many of them are now somewhat obscure, that we made a search for some fungus that might throw additional light on *Diaporthe parasitica.* In this search we asked the aid of Professor Farlow, whose knowledge of American fungi is unsurpassed, and who has some of the Schweinitzian specimens in his herbarium, and from him we first learned of the close relationship of the chestnut blight to *Endothia gyrosa* (Schw.) Fr. This fungus was first described by Schweinitz as *Sphaeria gyrosa,* from North Carolina on Fagus and Juglans. He sent specimens to Fries, a famous authority on fungi in Europe, who later recognized it as a European species, and finally placed it under a new genus, Endothia. This possible relationship of the blight was brought out for the first time in the writer's Report (6) for 1908. Neither Farlow nor the writer had at that time examined the ascospore stage of the true *Endothia gyrosa,* so the exact relationship of our blight fungus to this species was not positively determined, though the writer called attention to the fact that, so far as one could tell from the Cytospora stage, it was impossible to distinguish between *Diaporthe parasitica* collected on chestnut in America and *Endothia gyrosa* found on the same host in Italy.

Previous to this, however, Rehm (61) had decided that Diaporthe was not the proper genus for our chestnut blight, and had placed it under the genus Valsonectria, but had not questioned its identity as a new species or its relationship to Endothia.

Von Höhnel (29) seems to have been the first to definitely state that *Diaporthe parasitica* was not distinct morphologically from *Endothia gyrosa,* for in the latter part of 1909 he wrote: "Diese Pilz ist in Rehm Ascomyc., No. 1710, ausgegeben unter dem Nahmen *Valsonectria parasitica* (Murr.) Rehm. Es ist aber nicht anders als *E. gyrosa* mit schwach entwickelten Stroma." Since then Farlow (20), Shear (65), Saccardo, and Rehm, the last two in letters to the writer, have also decided that the chestnut blight fungus is not distinct morphologically from *Endothia gyrosa* (sometimes called *E. radicalis*) of Europe.

The Andersons (1) were among the last to study the relationship of *Diaporthe parasitica* to the genus Endothia. Their studies having led them to believe that the blight fungus, though related, was entirely distinct from *Endothia gyrosa,* they have placed it under Endothia as *E. parasitica* (Murr.) Anders.

Although the writer started out to prove the identity of the chestnut blight with the *Endothia gyrosa* of Europe, he has been forced to conclude from his microscopical, cultural and inoculation studies that it is not exactly identical with that species, as is held by von Höhnel and others. The relationship, however, is so close that he cannot, on the other hand, agree with the Andersons in considering it an entirely distinct species. Hence he (9) has placed it as a variety under that species, calling it *Endothia gyrosa* var. *parasitica* (Murr.) Clint.

The preponderance of opinion of those who have made a critical study of the fungus, therefore, is that it is not an entirely new species, but that it is merely a strain, or at most, a variety of a previously described saprophytic or semi-parasitic species, that for certain reasons has now attained unusual virulence in the northeastern United States.

CHARACTERISTICS OF THE DISEASE.

As to the Host. It is easy enough to distinguish this disease on the smooth bark of sprouts or young trees, Plate XXIII a, since it forms definite cankers by killing the infected bark, and these usually increase in size until the entire stem or limb is girdled. These cankered spots are slightly sunken, and distinguished from the healthy bark by a chestnut-brown color, whereas the normal bark is more of a greenish-brown. Often the bark on these cankered spots is more or less cracked, and in time the fruiting pustules show as numerous minute cushions projecting through lenticel-like openings.

On the rough bark of the older trees the cankers do not show very distinctly, though when cut out, as shown in Plate XXIII b, they give a cankered effect. Frequently with these the whole bark becomes infested, and the presence of the fungus is shown by the fruiting pustules breaking out from the deep cracks of the bark. Often when these do not develop

the bark may look healthy, but when hit by a hammer, it gives a hollow sound and is easily separated from the wood, showing the cambium entirely dead. After the tissues are killed, one is apt to find the larvae of beetles, etc., at work between the bark and the wood, and their presence has led some to think that they were the real cause of the trouble.

The first appearance of the disease on the smooth bark frequently seems to be due to the injuries caused by bark miners, Plate XXIV a. The most frequent starting points, however, are through cracks, wounds or where a branch has been pruned, XXIV b, or killed from some cause, as winter injury. Very frequently the fungus gets a start from a crack in the crotch of the limbs.

In summer time the disease is recognized in the top of the trees, even at some distance, by the dead leaves on certain branches, which have been girdled, but whose girdled area is not easily seen from the ground, Plate XXII a. These dead leaves adhere for a long time to the branches. They first begin to show about the latter part of June or the first of July, when the previous year's canker has finally succeeded in girdling the branch. In the winter these dead branches sometimes retain their dead foliage and burs long after those from healthy branches have fallen. This is true, however, of a branch killed prematurely from any cause.

The cankers on the main trunk, as they become serious, cause the latent or adventitious buds in the healthy tissues beneath to develop, so that in time there are produced a number of slender sprouts, and one can detect the presence of a canker high up in the tree by these.

The fungus, while it kills the bark and cambium, and thus eventually the tree, is not a true wood-destroying species. When the trunk of a living, but cankered, tree is cut and barked, the cankered spot, Plate XXIII d, is usually visible as a darker area in the wood corresponding to the cankered spot in the bark, the mycelium of the fungus having injured the woody tissues for a short distance inward. Such cankered spots can sometimes be seen on telephone poles used along the highway. This injury in itself, however, is negligible so far as it affects the value of the pole.

Often, after trees are cut, the stumps of those infected at the base develop a vigorous growth of the fruiting stage on the three or four outer rings of wood. This probably means that the mycelium can penetrate thus far into the wood from the canker, or possibly it may mean that fresh infection takes place from spores developing in the nutrient material furnished by the exposed sapwood.

After an infected tree has been killed, or has been cut before death, there may be a further development of the fruiting stage of the fungus. We doubt, however, if disease-free trees often develop prominent infection after cutting. In other words, the fungus is parasitic or semi-parasitic, but does not develop in its prime as a saprophyte. Even on trees killed suddenly and left standing, Plate XXII b, we have often failed to notice a general spread of the fungus through the bark. In the wood pile, too, while the fruiting stage no doubt shows some increase, a general subsequent infection of the disease-free bark does not seem to take place.

As to the Fungus. The mycelium of the fungus ramifies through the bark, beneath it, and often into the wood for a short distance. When the epidermis of a young, smooth, cankered branch is carefully peeled off, it often shows the mycelium as a whitish or yellowish coating just beneath, and below this is the reddish-brown diseased bark sharply marked off at its edges from the healthy white tissues. In the older infected bark, the mycelium is sometimes seen as fan-shaped areas between the tissues or on the wood. The mycelium often gives a mottled effect to the bark as seen when cut through. In time, with the aid of insects, it produces soft, semi-dusty spots in the firmer, less affected tissues.

The infected tissues do not show external signs of the fungus itself at first (with artificially inoculated cankers, not for two months or more after inoculation, Plate XXV b), but in the smooth bark in time numerous fruiting pustules are gradually protruded through small, lenticel-like openings. These at first are quite small, but in time show as subspherical to irregularly oblong cushions one-eighth of an inch or less in length and about that in height, XXIV c. In the rough bark they break out more irregularly from the crevices, and are more run together into compound groups, XXIV d. They vary in color

with age from light-orange through almost crimson- to dark chestnut-brown. The interior of the pustules is usually lighter colored, and more uniformly remains of a yellow tint. When fully matured, the fruiting pustules show small black dots on the surface or in cross-section, which are the ducts through which the matured spores escape.

On the wood, the fruiting pustules are usually simple, smaller, conical in shape, and apparently do not produce the mature stage of the fungus. They have an appearance to the eye quite different from those on the bark, and for this reason Saccardo formed a distinct genus, Endothiella, for them.

The pustules, within inconspicuous cavities, soon begin to form a summer, or conidial, stage. This, if it were the only stage produced, would place the fungus in the imperfect genus Cytospora, so this is sometimes known as the Cytospora stage of the fungus. The spores are produced apically in great numbers from slender fruiting threads. When filling the cavities and swollen by moisture, they ooze out over the surface of the pustules as drops, or more frequently, slender yellowish tendrils. These tendrils are most conspicuous in summer just after rainy weather. Soon, however, they become worn or washed away by rains, and, if carried to cracks in the bark, they cause new infection.

As the spore masses are viscid and moist, they easily adhere to insects, especially when crawling over them in the larval stage, and to the feet and beaks of birds, and these are considered means of spreading infection, not only in the neighborhood, but also to distant points. These spores, Plate XXVIII i, are very minute, in fact, so small that it would take two or three hundred million to cover an area an inch square. They are hyaline, oblong, unicellular with rounded ends, and about 2.5-4 x 0.75 μ in size.

In the same fruiting pustules that produce the Cytospora stage there appears, after some time, the mature spore stage, often called the winter stage, because it occurs most commonly from late fall to late spring. However, like the summer stage, this winter stage can be found more or less abundant at any time of the year, its appearance depending in part on the age of the fruiting pustules. With the beginning of this stage, the fruiting pustules have reached their maximum growth and the production

of the summer spores is practically over. It is quite unlike the Cytospora stage in that the spores are borne in sacs, or asci, situated in special receptacles called perithecia.

The mature perithecia, Plate XXVIII k, are minute, light to dark-colored spherical bodies, situated within, but generally beneath and around, the edge of the pustules. By means of long black necks these perithecia open on the exposed surface of the fruiting pustules, where they show as minute black specks called ostioles. With the later growth and wearing away of the fruiting pustules these ostioles sometimes project as short spines. Each perithecium contains numerous, hyaline, oblong, asci, Plate XXVIII f, tapering somewhat at their base, within which are eight ascospores arranged one above another in one or two rows. In size the asci usually vary from 40 to 45 μ in length by 7 to 9 μ wide, though some vary from 37 to 50 μ in length.

The ascospores, Plate XXVIII c, are hyaline, oblong to broadly oval, with a central septum, at which they are often slightly constricted. These spores are usually rounded at the ends, though sometimes somewhat pointed at one or both ends. They vary from 6 to 10 μ in length by 2.75 to 5 μ in width. While the chief time of germination of the ascospores is undoubtedly in the spring, their production and germination seems to be more or less distributed throughout the year. After rainy weather they are shot through the ostioles of the perithecia with some little force, and no doubt may be carried much further by the wind. By this means their distribution is greatly facilitated, and, because of their greater vigor, some experimenters believe they are more important in producing infection than the conidial spores.

Progress of Disease. From our inoculation experiments it is evident that seedling trees one-half inch or less in diameter may be girdled, and in some cases their tops killed in one season, Plate XXV a. Sprouts an inch or more in diameter may likewise be entirely girdled for a distance of six or more inches, so that the death of the parts may be expected at least by the following spring. We have not inoculated the large limbs of trees, neither have we measured the rate of growth of cankers on the same, but we have had under general observation, for several seasons, marked trees at both Stamford and Middlebury.

From the results of these observations, it seems to take at least two, and more frequently three, four or more years, to entirely kill the larger trees.

The trees at Stamford were on the farm of Mr. F. V. Stevens, and we are indebted to him and his son for aid in the experiments there. The trees were first marked by the writer and Mr. Filley in April, 1909. At that time many of them were in bad condition, as they were in the region where the blight first made its appearance in this state. All of the trees and sprouts in a certain area were numbered, and their condition as regards blight recorded. They varied in size from sprouts 2 to 8 inches in diameter to large trees two feet in diameter. The following table shows their condition when first examined, and after two growing seasons. They were not examined in 1911. In 1912, according to Mr. Stevens, Jr., all of the infected trees were dead; some of the sprouts, especially those developed since the marking, however, were alive. In 1910 some of the dead sprouts did not show any, and others but little signs of the fungus, and their death may have been partly due to other causes, as drought and winter injury, though all are included in the following table.

	Sprouts, 2-8 in. diam.				Trees, 10-24 in. diam.			
	Apr. 1909.		*Nov. 1910.*		*Apr. 1909.*		*Nov. 1910.*	
	No.	%	No.	%	No.	%	No.	%
Free	26	25.7	7	6.9	7	29.2	0	0
Little diseased	28	27.7	10	9.9	8	33.3	1	4.2
Moderately diseased	14	13.9	4	4.0	2	8.3	3	12.5
Badly diseased	24	23.8	15	14.8	2	8.3	10	41.7
Dead	9	8.9	65	64.4	5	20.8	10	41.7
Totals	101		101		24		24	

The trees at Middlebury, all above six inches in diameter, were in a grove belonging to the Whittemore estate. For their experimental use the Station is indebted to the farm superintendent, Mr. W. M. Shepardson. The trees were on a hillside having a southern exposure, and had recently been thinned, by taking out those most diseased. They no doubt suffered from blight more severely because of winter and drought injury, due in part to their exposure and the thinning. The trees were first examined in February, 1910, and marked, but not numbered, with a sign indicating their condition as to

the disease at that time. They were examined again and re-marked at the end of that season, and examinations were made again at the end of the seasons in 1911 and 1912. In these later examinations data were not taken from all of the marked trees, but the condition of each tree examined was compared with its condition in the fall of 1910. The badly diseased and dead trees increased from 5.7 per cent. in the spring to 35 per cent. in the fall of 1910, to 58 per cent. in 1911, and to 69 per cent. in 1912. The following table shows the conditions at the different times of examination:

	Feb. 1910.		Nov. 1910.		Fall, 1910.		Fall, 1911.		Fall, 1910.		Fall,	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	
Not diseased......	67	42.7	0	0	24	20.5	0	0	12	21.8	0	
Little diseased.....	67	42.7	68	43.3	40	34.2	25	21.4	25	45.5	8	1
Medium diseased..	14	8.9	34	21.7	22	18.8	24	20.5	9	16.4	9	1
Badly diseased....	9	5.7	55	35.0	31	26.5	44	37.6	9	16.4	21	3
Dead..............	0	0	0	0	0	0	24	20.5	0	0	17	3
Totals..........	157		157		117		117		55		55	

DISTRIBUTION AND HOSTS.

In the United States. The blight, first noticed in the late summer of 1904 at Bronx Park, New York, was said by Merkel to have spread by the end of 1905 so that 98 per cent. of the trees in this borough were infected. Murrill (45), in June, 1906, reported the disease from New York, New Jersey, Maryland and Virginia, and in September also from the District of Columbia. In February, 1908, he (48) gave Connecticut and Massachusetts as additional states. Metcalf and Collins (36) showed the distribution by August, 1909, to include Rhode Island, Pennsylvania and Delaware. Except in the vicinity of New York City, including adjacent parts of New York, Connecticut, Long Island and New Jersey, the points of infection at this time, so far as known, were scattered rather than general. In May, 1910, Metcalf and Collins (37) included West Virginia among the infected states. The past year the disease has been reported also from New Hampshire and Vermont.

At the present time the most damage caused by this disease in Massachusetts and Connecticut has been along and west of the Connecticut river. In New York it is conspicuous along the Hudson River up to Albany, and in western Long Island.

In New Jersey the chestnuts of the whole state have suffered. In Pennsylvania the trouble is serious in the eastern half, and quite bad in the southeastern part. The disease occurs generally in Delaware, but is especially bad in the northern counties, where the chestnuts are most abundant. Maryland and Rhode Island have the disease scattered, and serious in certain localities. In Virginia and West Virginia the infections are apparently few and inconspicuous.

In Connecticut. The first specimens from Connecticut were sent to the Experiment Station in November, 1907, by F. V. Stevens, Jr., of Stamford, who found the disease doing considerable damage in this region during the summer. He also mentioned that he thought he had seen it in one or two other towns in the state. Since that report others have stated to us that they had seen the disease earlier, but had not known its nature at the time. For example, Mr. G. H. Hollister, of Keney Park, Hartford, said that in the summer of 1905 he found a tree on the Edgewood Park estate at Greenwich that he is now sure had the blight. Forester Spring reported that a farmer in the town of Easton noticed the disease as early as 1905. These three towns are all in Fairfield County, near the first reported outbreak in New York.

Hodson (28) reported the blight in New London County as early as 1908. Mr. N. J. Peck brought us a specimen from Woodbridge, New Haven County, in the winter of 1909, and reported that he had seen it in his woods for four or five years. The first fruiting specimen collected by the writer outside of Stamford was found at Morris Cove, New Haven County, in September, 1908, though immature specimens were seen that spring in Westville.

By the end of 1908 the disease had been reported in all but one of the twenty-three towns of Fairfield County, in eight towns of New Haven County, and in one town of New London County. By March, 1911, the writer (7, p. 716) had reports of it in all of the twenty-three towns of Fairfield County, twenty-one in New Haven, fourteen in Litchfield, seven in Hartford, two in Middlesex, three in Tolland, and one each in Windham and New London counties. Out of these seventy-two towns all but seven were west of the Connecticut River. In November, 1911 (11), it was reported in 121 towns of the

state, and in February, 1912 (12), it had been found in 164 out of 168 towns of the state. Since that time it has been reported in the remaining four.

We have no doubt that a careful examination would have revealed the blight's presence in many of these towns much earlier than it was first reported. There is no question, however, that it was much more conspicuous in Fairfield and New Haven counties at first than elsewhere, and that to-day it is much more prevalent west than east of the Connecticut River. This is probably due to the fact that in the western part of the state chestnut is more abundant than in the eastern half and also to the fact that the disease started earliest in the southeastern part of the state. We doubt very much, however, if it has spread from a single infected locality in Fairfield County through all the rest of the state, but hold rather to the idea that it was present in a very inconspicuous way in a number of localities scattered over the state, and has spread from these. See Plate XXI.

Manner of Distribution. Many persons believe that the chestnut blight started at some one locality in the region of New York City and from there spread to all of the localities where it is now known to occur. Maps issued from time to time by Metcalf and Collins are based on this idea. Williams (54, p. 198) has rather positively stated this in the following quotation: "I would like to ask the gentlemen from around the neighborhood of New York City whether if they had been really active and alert and on the firing line when this thing was discovered in 1904, might they not have accomplished some real thing which would have redounded to the benefit of the other states, as Massachusetts has done in her gypsy moth fight? If instead of sitting down and nursing their hands in idleness, and allowing the scourge to go on, simply because they could not originate sufficient interest in their state, they had gone out and done what they could, this thing would probably not have come upon us."

This view almost of necessity carries with it the additional belief that the chestnut blight is of foreign origin, since if of native origin there is little likelihood that the fungus would have been limited to one locality; whereas if imported, it could have spread from one center or even from a single tree. On

the other hand, the writer holds the view, at least tentatively, that the chestnut blight has not spread from a single central locality in New York City, but that at the time of its discovery there in 1904 it occurred in an inconspicuous way in widely scattered spots in several states, and that it has been in these localities for years.

The reasons for this belief are as follows: (1) While originally reported from the New York Zoological Park in 1904, subsequent information has shown that at about that time, or even earlier, in several cases already cited, the disease was present in such widely separated places as Woodbridge, Stamford and Greenwich, Conn.; Huntington, L. I.; Bronx Park, N. Y.; Bergen County, N. J.; Lancaster County, Pa., and Bedford County, Va. (2) Its sudden appearance and quick destruction of the trees where first found (98 per cent. infected by end of 1905, as reported by Merkel) indicate that there was some other factor involved than the spread of a virulent parasitic fungus, since such quick work is without parallel in the history of other fungous diseases of trees, or even with this one in its later history. (3) Recent investigations have shown that the fungus is more likely native than imported, and if native, there is no good reason why it should have been limited to the immediate vicinity of New York City. (4) Our investigations in Connecticut have shown it present in some localities in an inconspicuous way at the base of the trees, as if it were a native instead of an introduced fungus, just as its nearest relative is found to-day in the South. This latter fungus, *Endothia gyrosa*, is so generally distributed in the South that there is no doubt that it has occurred there since Schweinitz's time, and yet no one had, previous to our investigations, reported it on chestnut in that region.

We believe that the chestnut blight fungus existed in the North previous to its outbreak in 1904 as a weak parasite in a number of scattered localities. From these centers it spread with greater or less rapidity according to local conditions. This belief does not in any way contradict the possibility of the disease being carried longer or shorter distances by such agencies as infected nursery stock, birds, etc. Perhaps the strongest evidence against this belief is the fact that the greatest damage has occurred in the vicinity of New York City, and

apparently has spread outward with the development of seemingly new infections. This apparent wave of progress, however, is in part due to a corresponding wave of interest on the part of the people to locate a disease so generally discussed. It is quite doubtful whether the disease was observed in most of the localities as soon as it made its appearance there, but rather our experience has been that it was usually discovered in a place when someone became interested enough to search for it.

Hosts, Resistance, etc. While the blight was first found on our native chestnut, *Castanea dentata*, and most of the damage has been done to this species, it was soon determined that other species of Castanea were more or less susceptible to the disease. Murrill (48, p. 27) in 1908 called attention to these hosts, as follows: "It is now certain that the chestnut disease attacks all species of Castanea, both native and cultivated, that occur in this region, namely, *Castanea dentata*, the common native chestnut, *C. crenata*, the Japanese chestnut, and *C. pumila*, the chinquapin, found native from New Jersey to Florida." The European chestnut, *Castanea sativa*, though not mentioned by Murrill, is now known to be about as susceptible to the disease as our native species. At first certain varieties of this, as the Paragon, were thought to be more or less immune, but subsequent observation has not shown any that possessed marked resistance.

Concerning the infection of the Japanese chestnut, Murrill said: "This discovery is especially timely because of the fact that the Japanese chestnut has been under observation elsewhere in the vicinity of affected native trees, and has been considered immune, so that it has been mentioned as a desirable substitute for the native tree in some of our parks." Metcalf also had noticed this apparent resistance of the Japanese chestnut, and published a short bulletin (33) in February, 1908, in which he says: "Observations made by the writer the past year indicate that all varieties and species of the genus Castanea are subject to the disease except the Japanese varieties (*Castanea crenata* Sieb. & Zucc.). All of the latter that have been observed in the field or tested by inoculation have been found immune. This fact can hardly fail to be of fundamental importance to the future of chestnut culture. Although the nuts are distinctly

inferior in flavor to the European varieties, such as Paragon, the Japanese is already grown on a large scale as a nut-producing tree. There are, however, many trade varieties of dubious origin. Some of these may prove later to be subject to the disease."

So far as the writer has observed in Connecticut, the Japanese varieties seem to have more or less resistance to the disease, but our experience has not been very extended. We have seen two cases, one in a nursery and another in a private yard, where the Japanese species was directly attacked by the blight, but have examined it in nurseries several times without finding any sign of the disease. We also failed to produce the disease in a Japanese variety in the Station yard, although the bark was inoculated in sixteen different places.

In April, 1910, with the aid of the State Forester, we had set on the hillside, beside a badly diseased patch of chestnut timber on the Whittemore estate in Middlebury, six young trees each of the following varieties: Paragon, Reliance, Early Bon, Japan Mammoth, Late Tamba and Alpha, mostly Japanese varieties. These were planted to see if any would escape the blight. Unfortunately, many of them were killed back to the ground the first summer by drought. On the stems of some there appeared on the exposed southern side sun-scald cankers similar to those described by Powell, but no sign of the blight fungus showed that year. Since then a number of the trees have died from drought, but none have been killed or seriously injured by the blight fungus, though in 1911 a little of the fungus was found on two of the badly injured Japanese Mammoth, and in 1912 on two of the languishing Paragon trees cankers had started. The Paragon, of all the varieties, stood the transplanting and drought conditions the best.

Some years ago, through the work of the late Judge Coe of Meriden, Mr. Hale of Glastonbury, and Dr. Britton of this Station, considerable interest was aroused in the cultivation of chestnuts, especially the large fruiting varieties. While we know of no cultivated orchards that were set out, a number of men grafted these varieties onto the native sprouts and trees. Among these were W. O. Corning of Marbledale, and Mr. John Dickerman of Mount Carmel. Both these gentlemen say their grafted trees have been badly injured by the

blight. Mr. Corning writes: "Of my Japanese trees a great many will have to be cut down. At the same ratio of progress, none will be left in three years." And in another letter he states further, in answer to our inquiry: "I bought in New Jersey cions for four kinds, namely, Japanese, Numbo, Ridgely and Paragon, all on chestnut sprouts. I bought at the same time trees from seedlings, but they all died before the blight struck us. I find the Japanese stand so far the best. The Paragon are the poorest, although they have made the best growth and produced the most chestnuts. I find the infection commences about at the juncture of the grafts on the sprouts, and runs up and down, faster up than down."

Dr. Robert T. Morris, of Stamford, has experimented more with different varieties than anyone else in the state, so his statement, following a discussion of a paper by Collins (13, p. 43), is of special interest: "In my own orchards I have twenty-six kinds of chestnuts, and have followed them along for the purpose of determining which ones would resist the blight best. I cut out last year [1910] five thousand old American chestnut trees on my property. There is not a tree in all that part of Connecticut, the vicinity of Stamford, that is not blighted, and very few that are not dead. Now, in the midst of this disaster, what was the behavior of my experimental chestnuts of various kinds? It was this. I had about one thousand Coreans that lived up to five years of age, growing in the midst of blighted chestnuts, and none of these blighted. It occurred to me that it might be well to graft these on the stumps of American chestnuts, because these Coreans resisted the blight. But when I grafted them on the sprouts of American stumps, at least 50 per cent. of the Coreans blighted, showing that the pabulum wanted by the Diaporthe seemed to be furnished by the American chestnut. I had some chestnuts from North Japan that resisted the blight, and yet these grafted on sprouts from American chestnuts blighted. I had some Chinese chestnuts, and none of those have blighted as yet; and in grafting them, two or three have not been blighted. I have perhaps twenty-four chinquapins, both the Western form and the Eastern, and only one branch of one tree has blighted. Of the Southern Japanese chestnuts, very many are blighted. They are not as resistant as the Northern. I have a good many

chestnuts of European descent, and among these some resist the blight pretty well; and some of the American progeny, like the Hannum and Ridgely, seem to resist well enough, so that I am grafting these upon many different sprouts."

As interest became aroused, inquiries have been frequently made if other trees than the chestnut, especially oaks, were not attacked by this fungus. For a long time its occurrence was not reported on any other host than Castanea. Even as late as April, 1912, Metcalf (35, p. 223) published the following: "So far as is now known, the bark disease is limited to the members of the genus Castanea. The American chestnut, the chinquapin, and the cultivated varieties of the European chestnut, are *all readily subject to the disease. Only the* Japanese and some other East Asian varieties appear to have any resistance."

Fulton *seems to have been the first to* report *the chestnut* blight on oak, having exhibited cultures in December, 1911, at the Washington meeting of the American Phytopathological Society. *In his* Harrisburg *paper* (24, p. 53) he *reports finding* a fungus on white and black oak in Pennsylvania, and says concerning it: "While it is desirable to carry on further cross inoculation experiments, it seems reasonable to suppose in the light of present evidence that *Diaporthe parasitica* may, under unusual circumstances, establish itself saprophytically on portions of trees outside the genus Castanea, if these portions are already dead. We have found no evidence that the fungus produces in any sense a disease of such trees as the oak."

The writer and Mr. Filley first found the chestnut blight on oak in October, 1912, at Middlebury, Conn., in a badly diseased chestnut grove on the Whittemore estate. Previous search for several years had failed to show it on any of the various species of oak examined. At this place the fungus occurred rather inconspicuously, as follows: (1) On an exposed living root of *Quercus alba* that had been injured in some way; (2) On cut surface of wood of a live stump of *Q. rubra* from which young sprouts were growing; (3) On the dead bark and dead stub of a twig on a recently cut stump of *Q. rubra*. Also, in November of the same year, Mr. Walden, of the entomological department, brought to the writer specimens of white oak from Greenwich, Conn., that had been killed by drought, on which

Cultures have been made from all these specimens and from a specimen of black oak, *Quercus velutina*, sent by Detwiler from Pennsylvania, and all have shown the characteristic growth of the blight fungus as distinguished from *Endothia gyrosa*, which also grows on oak in the South. However, in none of the cases so far reported does the fungus seem to have been an aggressive parasite on oak. We doubt very much if it ever will produce any serious trouble, since the oaks are hardier than the chestnuts, and have not been deteriorated through sprout renewal.

DAMAGE AND LOSS ALREADY CAUSED.

Character of Damage. The injury caused by the blight fungus to the wood of the chestnut tree is not considered to be very important. Lumber, poles or ties cut from recently killed trees are not distinguished, as a rule, from those taken from perfectly healthy trees, and no data have yet been produced to show that they are in any way inferior. This is because the fungus limits its attack to the bark, and the superficial layers of sapwood. After the death of the tree, the mycelium does not, apparently, form any progressive decay or deterioration of the wood.

If the blight killed only the old trees ready for marketing the damage would not be very great. Loss arises in part from the irregularity of its attack. Each season some trees die, thereby making cutting and marketing inconvenient. The market is often glutted so that they cannot be disposed of to advantage. Further loss may arise in the deterioration of the dead trees if they are not cut soon after death, through decay started by other fungi and by insect depredations.

The situation in Stamford, Conn., was shown in 1909 by Morris (42), as follows: "Millions of feet of fine chestnut timber, valuable for planking, piles, telegraph poles and cordwood, will be lost within the next two years. Right now the blighted trees are still good for cutting purposes. I tried to dispose of about one thousand chestnut trees, but could not find a purchaser. All my neighbors are in the same predicament. 'No market,' is the regular reply to all my letters asking dealers if they handle wood of any sort. Forty or fifty cords of hard wood were rotting on the ground last autumn because I could

not find any one that wanted cordwood that had been split and stacked while clearing part of the property three years ago."

The type of damage so far mentioned, however, is inconspicuous in this state as compared with the loss that occurs through the death of trees which are not yet fit for commercial purposes and can be used only for cordwood. The market for the latter in certain districts is easily satisfied. This means low prices or long storage. The greatest loss is caused where future profits are entirely cut out by the death of half grown trees and sprout growth too small for present use. If the disease progresses in the future as actively as in the past, the prospects of our chestnut forests are very poor indeed. This means serious loss, for the chestnut is one of the most useful forest trees in all parts of the country where it occurs.

Besides the loss from a commercial point of view, there is the damage caused to the shade and ornamental trees, and to groves kept on estates, parks, etc., for aesthetic rather than practical purposes. To estimate the damage here is impossible.

In the United States. Certain writers have attempted to estimate in money value the loss caused by the blight. Just how this loss is estimated is not made very clear. To the writer it seems to be largely guess work. However, it is interesting to note these figures in order to compare them with losses given for other fungous diseases and insects. Murrill (49) in 1908 estimated the damage in and about New York City between five and ten million dollars. Mickleborough (40) about the same time estimated the damage through the country at not less than ten million dollars, while in 1909 he (41, p. 14) wrote: "The damage already done in the states of New York, Pennsylvania and New Jersey, would not be less than twelve million dollars." Metcalf and Collins (38) gave twenty-five million dollars as a conservative estimate of the financial loss to the country up to 1911. Detwiler (19, p. 130) estimates the loss in Pennsylvania alone as ten million dollars, allowing seven million for forest and three million for ornamental trees. The largest estimate that we have seen is that given by Marlatt (31, p. 345), who said in 1911: "It is estimated that the loss in and about the City of New York is now between five and ten million dollars, and the loss throughout the area now infested is fully one hundred million dollars."

In Connecticut. We shall not attempt to give any figures for the loss in Connecticut. To do this, one would have to determine the future value of sprout growth, and with more mature timber, to determine the difference between what one really got out of it and what he would have received if there had been no blight. Some idea of the loss, however, can be gained by an estimate of the chestnut in our forests and the percentage already injured by the blight.

Hawes and Hawley, in their forest survey of Litchfield and New Haven counties, estimate the forest land in Litchfield as 55 per cent., and that in New Haven as 46 per cent., of their area. This gives a total of something over five hundred thousand acres of forest for these two counties. While considerable of this is in brush and some in white pine, by far the most of it is mixed hardwoods, with chestnut forming about 60 per cent. of these in Litchfield and 70 per cent. in New Haven County. Counting in all the forest land, Litchfield probably would run over 45 per cent. chestnut and New Haven over 50 per cent., according to these authors. Probably no other county of the state has proportionately so large a part of its area in forest as Litchfield, according to State Forester Filley, but on the other hand, New London is probably the only one that has a less proportion than New Haven County.

On the whole, it is perhaps safe to estimate 40 per cent. of all the forest land of the state as being chestnut. The census for 1910 gives the lumber cut of chestnut in this state for that year as 58,810,000 feet B. M., or nearly equal to that cut from all other trees. These statements show how extensive the tree is in our forests, and how useful. When we consider that from 5 to 90 per cent. of the chestnuts in different parts of the state have already been attacked by the blight, a clearer idea of the great loss already caused may be gained, especially in Fairfield County, where over large areas there is scarcely a chestnut tree to be found that is not either killed or infected by the blight.

PRESENT SITUATION AND FUTURE PROSPECTS IN CONNECTICUT.

In order to give some idea of the damage already done in different parts of the state the botanical and forestry depart-

ments of the Station, after consideration of all the data available, have made approximate estimates of the percentage of chestnut trees attacked in each of the counties. To gain more immediate information as to the condition in the different counties, the writer recently sent the following letter to about seventy-five men scattered over the state who have been especially interested in the blight and have had a chance to watch local conditions: "In 1911 the blight was more widely reported to us and was apparently more generally conspicuous than in any previous year. What we wish to learn from you is whether it was, where you observed it in 1912, more prominent, less prominent, or just about the same, as in 1911." Information gained by this and other means is given by counties as follows:

Fairfield County. The blight was first found by Mr. Stevens, Jr., of Stamford in the summer of 1907, and reported soon afterward to the Station. From Mr. Hollister's observations at Greenwich, the disease no doubt occurred in the county at least as early as 1905. The injury has been greater here than in any other county, and is apparently now on the decline, since most of the trees have been attacked or killed. The Station estimates 75 to 85 per cent. of the trees already dead or infected. In answer to our letter, three report the blight worse, and four about the same or less conspicuous in 1912 than in 1911.

Mr. F. A. Bartlett of Stamford writes: "The chestnut is practically extinct in Fairfield County." Mr. Joseph Cornwell of Norwalk says: "From my observations the chestnut blight was far more conspicuous in 1912 than in 1911. In 1912 I made a special trip into the woods for the purpose of examining the undergrowth, and found it more affected by the disease than at any earlier period. My observations were made in Wilton, Norwalk, Westport, Ridgefield and Redding."

Dr. R. T. Morris, who owns a farm near Stamford, says: "In the different years since the blight appeared some of my neighbors in the country have stated that they have observed more rapid progress than before, and others have expressed the opinion that we had less blight than before. As a matter of fact, so far as I can judge, there has been pretty steady progress of the blight from the first, and at the present time I do not know of a single unblighted tree in the vicinity of Stamford, Conn., although my men and I have taken long walks for the purpose

of finding a resistant tree in order to propagate this tree because of its individual characteristics. A great many thousand trees were examined."

On the other hand, Mr. F. V. Stevens, Jr., of Stamford, writes: "I have found that in this section of the state the blight has been far less prominent than in any year since 1908 on the young sprouts, which are practically the only chestnuts we have." Mr. J. H. Treadwell of Danbury also says: "I would say that in this section dead trees caused by the attack of previous years were more in evidence in 1912 than in 1911. However, it does not appear to me that attacks on healthy trees are quite as prominent in 1912 as in 1911."

New Haven County. This was the second county in the state in which the disease was reported. It was found by the writer in Westville in the spring of 1908. From the observations of Mr. Peck of Woodbridge, already alluded to, there is little doubt that it occurred in places here as early as 1905 or 1906. The damage has been second only to that in Fairfield County. Quite a little of the timber has been cut in recent years for use in brick kilns and brass foundries. This has resulted in considerable young growth, which is always likely to show the disease badly. In most of the forests many of the large trees have also been badly infected or entirely killed. We estimate that 55 to 65 per cent. of the chestnut has already been infected or killed. In answer to our letter, nine stated that they believed the blight was worse in 1912 than in 1911, while seven thought it about the same or even less conspicuous.

Professor R. C. Hawley of the Yale Forest School, who has charge of the New Haven Water Company's forests, writes: "My observations have been principally confined to timber merchantable for cordwood or larger products. On such trees I think the chestnut blight has spread steadily in 1912 both in number of trees which it has attacked and, of course, in progress on trees already attacked. From a practical standpoint I anticipate cutting out all the chestnut now merchantable in the vicinity of New Haven. My general impressions are that the disease is slowly spreading among the trees below cordwood size, although I have not devoted so much time to observing these trees."

Mr. W. M. Shepardson, of Middlebury, who has had considerable experience in cutting out diseased trees on the Whittemore estate, says: "The blight was much worse in 1912 here than in any other year, and, as near as I can estimate, spread as much last year as in all previous years put together, so that in badly infested areas few or no trees are left without disease. In the home woods, round the fireplace and on the hill, where all trees were taken out last winter that we could discern, we found in September 845 trees over one foot in diameter that were much diseased and a great many smaller ones."

Mr. G. H. Bartlett of North Guilford writes: "In the vicinity of North Guilford and North Madison the chestnut blight increased very rapidly in 1912. Young trees seemed to be less able to resist the attack than old and large ones. Present indications are that all chestnut sprouts will soon die. Some old trees seem likely to survive for a time."

Mr. E. C. Warner, of North Haven, says, however: "In regard to the chestnut blight I would say it was very much more prominent in 1911 than in 1912. I think it spread very fast in 1910 and 1911, and not very much in 1912. In some places where we cut the diseased trees, blight did not increase very much, and one piece of sprouts I was through the other day did not seem any worse than last year."

Mr. C. A. Metzger, of Mount Carmel, also writes: "As a whole, the blight seems about the same as last year. It does not seem to have advanced as fast as it has hitherto. On our Mount Carmel farm the number of trees infected this year seems less than the number last year."

Litchfield County. Our first knowledge of the occurrence of the disease in this county was due to specimens sent by W. E. Frost from Bridgewater in January, 1909. The next August Mr. F. V. Stevens, Jr., sent specimens from Harwinton and also reported the disease from near Winsted; and Spaulding (69) found specimens at Bantam in September. In January, 1910, E. M. Stoddard collected specimens at Litchfield, and in March W. O. Corning sent others from Marbledale. So by the beginning of 1910 the disease was certainly well established throughout this county. So far the blight has not caused so much damage as in New Haven County, though in some places it has been very severe. Several of the best observers here seem

to have noticed an apparent halt in the progress of the disease the past year, which, if continued for another year, will give hope that the chestnuts may escape the severe injury caused in Fairfield County. We estimate the infected chestnuts to be from 40 to 50 per cent. in this county. Of the reports received, seven indicate an increase of the trouble over 1911, while six say the disease was about the same, or less conspicuous.

J. H. Putnam, of Litchfield, writes: "I do not think that the chestnut blight has spread any worse the past season. Its ravages are more noticeable, as many trees previously attacked but not noticed, are now dead. The pieces where I cleaned it out two years ago do not show much spread since." In a later letter he adds this interesting statement: "We have no large trees killed, but have just cut a large tree seriously injured. The cankers on this showed that the disease had gained two to three inches in 1911, but only one-half to one inch in 1912, and in some places the new bark had held its own. Looking over a block of sprouts some ten years old, I found that where two years ago I had considered them doomed, they were making a splendid fight, and in some cases had apparently entirely overcome the disease."

Donald J. Warner, of Salisbury, takes a similar favorable view, as follows: "I do not think that there were as many trees attacked by the blight in 1912 as in 1911 in this vicinity. On our own property in 1911 we cut several infected patches, and around these patches there were quite a number of trees which died in 1912. Of course it is quite possible that these trees had the disease in 1911 and were missed by the choppers. I did not notice nearly as many new cases as in the previous year."

C. L. Gold, of West Cornwall, expresses the same view: "I have been cutting quite a lot of chestnut timber this last fall and winter, and find considerable evidence of the disease, which did not show much or at all before the tree was cut. However, the general appearance of our forests as we look at them from a distance showed but little signs of it the past season, nothing near as much as in the summer of 1911. It would seem as if the trees already infected would surely die, but from the

W. O. Corning, of Marbledale, however, reports a worse condition, as follows: "I sent two men this morning to cut out my next winter's wood, and I found a very bad condition, nine out of ten young trees about thirteen years old infected. I was on the same ground last winter, but I found only half as many diseased as to-day. Of my Japanese trees, a great many of them will have to be cut down, and with the same ratio of progress none will be left in three years."

Ellicott D. Curtis, of Bantam, likewise sees no improvement, as he writes: "In our own woods the blight is much more conspicuous than last year, and is doing much greater damage. Some of the infested woods were thinned last winter, and the diseased wood taken out. This winter the disease is very prominent in these, and it looks as if the chestnut would have to be cut clean. It looks to me as if our chestnuts were completely doomed, although I have not so far been able to find the disease in a small stand of trees about sixty years old."

F. V. Stevens also takes a similar view: "At Torrington the outlook is about as bad as it was here [Stamford] three years ago, i. e., it promises to cause a total loss of all the chestnuts in that vicinity."

Middlesex County. Forester Moss found a single infected tree in the state forest at Portland in March, 1910, and this is the earliest date we have for the disease in this county. Later examination, however, showed this infection to have occurred probably as early as 1906. The disease was seen by the writer at Middlefield and Middletown in March, and at Chatham and East Haddam in July, 1911. The blight as a whole is probably somewhat worse here than in Hartford County, but not so bad as in Litchfield. We estimate 30 to 40 per cent. of the chestnuts infected. Three persons report the disease worse, and three no worse, in 1912 than in 1911.

Mr. J. E. Doane, of Centerbrook, writes: "I find plenty of blight in the chestnuts, more in the young than in the older growth. I find about one-half of the twenty-year-old trees in a tract that I have are either dead or diseased. I do not believe that there is any chestnut about here that has escaped from the blight, and think it has spread more in the last year than any time before." D. Herdman, of the Wadsworth estate of Middletown, also thinks the trouble on the increase, as he says: "There

is no doubt in my mind but what the blight is more prominent on this estate in 1912 than it was in 1911."

W. S. Hungerford, of East Haddam, reports an improvement: "I noticed the chestnut blight as being more conspicuous in 1911 with a slight decrease in 1912." Mr. J. C. Reeves, of Portland, says: "I think it showed up more prominently in 1912 in some localities, and not so much in others. On my land it was decidedly worse. Not so much new disease, but the trees showed it more. I think there is a change on the state land where we have cut it out. In some places where we would get a load last year, we did not find a tree with the disease."

Hartford County. The first reports we had of the disease in this county were in the fall of 1910, Forester Filley having collected specimens at Hartland in September, and Spaulding (69) at Windsor, and L. H. Goodrich at Hartford, in October. In March, 1911, the writer found the disease at Granby. At present the disease is perhaps not as bad as in Middlesex County, though in some regions considerable damage has been caused. We estimate 25 to 35 per cent. of the chestnuts infected. Of the letters received from this county, three writers think the disease worse in 1912 than in 1911, and three think it was no worse.

Mr. G. H. Hollister, superintendent of Keney Park, Hartford, writes: "As we made a pretty thorough cutting of the diseased chestnut trees last winter, I have not found the tops of the larger trees so badly infected as last year. I have found a great many trees with one or more branches infected, and more young trees than ever before. Probably many of the older trees have the blight, but it is not easily seen at present. On the whole, I consider the disease more prominent in 1912 than in 1911."

S. W. Eddy, of Avon, says: "I looked over the woods yesterday, and would state that there is much more chestnut blight than last year. It showed up more in the young growth and small trees in the open. In fact, the woods and trees there show many leaves still holding on, and on looking them over, one can find the yellow or orange fruiting pustules."

R. S. Tryon, of Glastonbury, writes: "The blight is generally prevalent here, I should say more prominent in 1912 than in [illegible]

Have noticed two or three instances where healthy growth appears to be overcoming diseased portions."

F. H. Stadtmueller, of Newington, says: "We have as yet escaped any perceptible invasion of the chestnut blight in this immediate vicinity, consequently can make no comparative statements. Lumbermen of this neighborhood have reported it less prevalent in 1912 than in 1911."

New London County. Hodson (28) in 1908 reported the blight along the Connecticut coast to New London, and about that time or a year later Hazard, a Yale forestry student, reported it present in North Stonington. The first specimens we received from this county were sent from Gales' Ferry by Dr. C. B. Graves in May, and from Lebanon by T. E. Clark, in October, 1911. The disease does not seem so bad in this county as in the preceding, and yet is worse than in the two following counties. We estimate the number of infected trees as between 15 and 25 per cent. Only three answers to our letters were received, of which two said the disease was worse in 1912 than in 1911, and one reported it about the same.

Dr. C. B. Graves, of New London, writes: "I should say the blight was just about the same as to general prevalence, but it is my impression that the proportion of badly infected and dead trees may be somewhat greater." Walter C. Tanner, of Voluntown, says: "Where I noticed this blight in 1912, it was much more conspicuous than in 1911."

Tolland County. The writer saw specimens of the blight at Mansfield in July, 1910; Filley collected specimens at Bolton in November of the same year; and H. Wood sent specimens from Tolland in April, 1911. As yet the blight has done comparatively little harm in this county, less than in any other except perhaps Windham. We estimate the percentage of infected trees to be between 10 and 15 per cent. Of the replies received to our letter four place the disease as more, and three as the same, or less conspicuous in 1912 than in 1911.

E. G. Walker, of Union, writes: "There is very little chestnut blight in Union, and I do not think there was any increase over 1911." George Towne, also of Union, says, however: "More cases of the chestnut blight were observed by me in 1912 than in 1911. There is little doubt that it is spreading in this locality." Harry Wood, of Rockville, also thinks it on the

increase: "In answer to your question it is my opinion that the disease around here has steadily increased in the past two years."

George V. Smith, of Willington, says: "The blight is increasing quite rapidly in this town. In 1911 I did not observe more than a few cases. In 1912 I found it in colonies of infection. Some men tell me they are finding it everywhere in chestnut cuttings. Two years ago I did not find a tree on my farms. Now there are many." Professor C. D. Jarvis, of Storrs, writes, however: "Replying to your letter, I would say that in my opinion the chestnut bark disease has not been so conspicuous during the past year. Fewer new infections were discovered, and the spread of the disease seems to have been much slower in the sections where it was present."

Windham County. Former Forester Spring collected the first specimens we had from this county at Windham in September, 1910, while Filley and Stoddard reported it from several towns in the fall of 1911. The last two towns in the state in which we found the blight were in this county. The situation here is about the same as in Tolland County, or perhaps somewhat better, as we estimate only 5 to 10 per cent. of the trees infected. Two reported the disease worse, and four as the same or better in 1912 than in 1911.

Mr. W. H. Hammond, of Hampton, writes: "So far as my observation went on my own farm, I was of the opinion that the blight did not spread last year as much as I expected, but there were many reports of it in new sections of the surrounding towns." C. S. Hyde, of Canterbury, says: "I should say the blight was about the same as in 1911, but if anything not quite so prominent in this section." C. E. Child, of Putnam, says: "Less prominent in 1912." On the other hand, C. A. Tillinghast, of Danielson, writes: "I have found the chestnut blight spreading quite rapidly in this section, much more in 1912 than in 1911."

Future Outlook in the State. If we judge from what the blight has already accomplished in Fairfield and New Haven counties, and what it is now doing in certain parts of Litchfield, Middlesex and Hartford counties, there does not seem to be much hope for those regions where the blight has become firmly established. There are those who believe that the blight is bound to go on in the future just as it has in the past, which

means the death of all the chestnuts in the infected regions. On the other hand, there are others, like the writer, who believe that there have been unusual conditions that have favored the rise and spread of the disease so far, and that the crest of this wave of infection is bound to be reached, and a gradual decrease to follow when these conditions are changed.

The blight has become far too prevalent and widespread to show sudden improvement in a single year, yet we believe that a let-up in its destructive spread was shown in the year 1912. In 1911, according to all our information, blight was by far more conspicuous and became more widely distributed than in any previous year. This was a year of serious drought, following several dry years. In the winter and spring of 1912 numerous rains replenished very largely the depleted supply of water in the soil, so that even trees in general that had not suffered seriously from any particular trouble showed decided improvement in foliage and growth. This was especially true of the peach, which is a very good indicator of weather conditions. True, there was a drought period in midsummer in 1912, but this did not affect trees so much as it did the superficially rooted crops.

Now, if weather conditions have had nothing whatever to do with the spread of blight, so far as increased or decreased vigor of the chestnut trees is concerned, then the blight in 1912 should have been far more prominent, destructive, and widespread than in any previous year. Yet, thirty-one out of sixty-four persons answering our letter stated that the blight was no worse, or even apparently better, in 1912 than in 1911. If our observations and those of the persons who corroborate them are true, then there is certainly some hope for the future of the chestnut in Connecticut. Just what percentage of the trees will survive the blight we do not aim to predict, but we certainly do not believe they are all to be exterminated.

RELATION TO CONDITION OF HOST.

General Statement. Some writers believe that the condition of the host has had no influence whatever on the rise and spread of this disease. For instance, Metcalf and Collins (37) in 1910 said: "A debilitated tree is no more subject to attack than a

healthy one. * * * Dry weather checks the disease by suppressing spore production. * * * Winter injury is not common over the whole range of the bark disease, but may be locally important in producing lesions through which the parasite enters. Winter injury bears no other relation to the bark disease." Metcalf (35, p. 225) in 1912 said again: "No definite evidence, experimental or otherwise, has been adduced to show that a tree with reduced vitality is more susceptible to infection, or that the disease spreads more rapidly in such a tree than in a perfectly healthy and well nourished tree of either seedling or coppice growth, provided that such reduced vitality does not result in or is not accompanied by bark injury by which spores may gain entrance."

Now, if the condition of the host bears no relation to the rise and spread of the disease, the writer knows of no satisfactory explanation for its sudden and destructive appearance in this country except its importation from some foreign country. The evidence to date, however, is very strongly against the idea that it is an imported pest, as we shall show later. Among the farmers in Connecticut who have been able to watch this disease rather closely there are many who believe that the weakened vitality of the chestnuts has had considerable to do with its development and spread in this state. The writer more than anyone else has advocated this view, and we propose to give here the reasons we have for holding it. Briefly expressed, they are as follows:

The chestnut blight was brought to sudden prominence just after the severe winter of 1903-04, which injured and killed fruit and forest trees in general along the coast and watercourses, of which New York City was the central point. The resulting enfeebled condition of the chestnut enabled the blight, a previously inconspicuous parasite, to spring into sudden prominence on these trees and to gain credit for the death of others which had been largely or entirely due to winter injury. Since then we have had one or two severe winters, and more especially several dry summers, that have injured not only the chestnut, but other forest trees over an extended area. Due to its successful attack on the weakened trees, the blight fungus has perhaps acquired an added virulence that has enabled it to attack apparently healthy trees, especially those of sprout

renewal. The enfeebled condition of the chestnut trees and their consequent susceptibility to the blight may possibly be related to some lessened chemical activity in the bark and newly-formed wood, such as the production of tannic acid, for instance. If so, then when this has returned to its normal production through favorable weather conditions, the blight should gradually become correspondingly less aggressive. Under the following heads we shall take up more in detail our ideas of the relationship between weakened vitality of the chestnut and consequent susceptibility to the blight.

Winter Injury. We have in a previous Station Report (6) called attention to the results of winter injury on fruit and other trees in Connecticut. We shall attempt here to show also that these conditions were not confined to this state. In December, 1902, following a very open fall, the temperature suddenly fell below zero, with the result that many trees, especially young fruit trees which had not properly matured their wood, were severely injured or killed outright. The following winter of 1903-04 was so unusually severe that thousands of fruit trees in Connecticut, especially those situated in the valleys and on the lower slopes, were killed, and others so severely injured as to develop physiological troubles for some time afterward. The injuries caused by these two winters were most noticeable in the region along the Sound, in the valleys or on the lower hill slopes, and along the river courses, regions in which the chestnut blight afterward first appeared, and in which it has caused the most damage. The winters of 1906-07 and 1907-08 also caused considerable winter injury.

Although we did not at the time directly study the effect on the forest trees of these winters, especially that of 1903-04, which was the most severe, we do know from subsequent observations that many trees were injured. In the summer of 1904 we examined a young fruit orchard, at Stamford, whose wood had been largely killed by winter injury; and two or three years later in examining chestnuts from this region, where the blight has been the most severe, we could see indications of winter injury to the wood of the chestnut sprouts dating back to the winter of 1903-04. In the winter of 1910, in examining chestnut at Middlebury, where the blight was just coming into prominence, we found quite a number of

injured and dead trees with no sign of the blight on them. There were others with the bark killed on the south or southwest exposures, and sound on the northern, as shown in Plate XXIII c by the dark and white wood; and on many of these there were no signs of the blight fungus as yet. There is no doubt that these trees had been injured by an attack of sunscorch winter-injury, complicated probably by summer droughts. That we are not alone in believing that these winters did not confine their injurious effects to Connecticut or to fruit trees, that they may have had some connection with the chestnut blight, and that some persons have attributed their effects to fungous and bacterial troubles in certain cases, we shall attempt to show by the following quotations.

Concerning the injury to fruit trees caused by the severe winter of 1903-04, Waite, of the United States Bureau of Plant Industry (Bull. 51), writes: "The severe cold weather of the past winter, especially the intense cold of January 4th and 5th, resulted in very severe damage by freezing to orchards in New York and New England, especially in the Hudson and Connecticut valleys. The damage was found to be mainly to peach, Japanese plums and pear trees, and the most serious harm was largely confined to the lower levels and pockets."

Eustace, of the Geneva, N. Y., Station (Bull. 269), in his discussion of this winter injury, says: "The winter of 1903-04 was an unusually severe one throughout New York state. In many places the temperature was the lowest on record, and the periods of extreme cold were protracted. As a result the end of the winter found many of the orchards, especially those of peaches and pears, extensively and seriously injured. * * * The damage was greatest in the Hudson River valley, where the cold was most severe, more than forty degrees below zero being reported. * * * At the end of the winter the external appearance of the trees was entirely normal, the bark of the trunk was smooth and of normal color, and the twigs on all parts of the tree were plump and bright. Nothing about the trees looked unusual or wrong, but upon cutting into the trunk anywhere above the snow line, it was found that both bark and wood were discolored for some depth into the trunk. * * * Altitude, air drainage, and condition of the soil had a very important bearing upon the severity of the injury. The advantages of a high altitude were best

shown in some of the peach orchards in the Hudson Valley. * * * The dying of the trees (afterwards) at such unusual and irregular times gave rise to much alarm among the fruit growers in some localities. It was feared that a virulent attack of the yellows had broken out, or some new and serious disease had become prevalent."

Whetzel, of the Cornell, N. Y., Station (Bull. 236, p. 133), says concerning a supposed outbreak of the bacterial blight of apple in that state: "Anything that reduces the general vitality of the tree tends to render it more susceptible to attack of the bacteria. I have already referred to the apparent effect of low temperature in relation to this disease in the Hudson River region. A long growing season during 1902, with excessive rain, followed by a sudden and extreme fall of temperature early in December, is referred to by growers in that section as the beginning of the injury to their orchards. The winter that followed was a severe one, with sudden and severe changes of temperature during the early days of the spring of 1903. Many trees failed to leaf out, and large cankers were now observed on limbs and bodies of dead and dying trees. The general conclusion at once prevailed that these dead spots were the *direct results of these weather conditions.* * * * *I am therefore of the opinion that many of the trees in the Hudson River Valley and about Kirkville were cankered prior to the winter of 1902-03. The severe weather no doubt weakened the trees* yet free from the disease, thus rendering them more susceptible to attack during the summer of 1903. * * * The winter of 1903-04 was also a severe one, and no doubt added to the sum of the injury already produced. To just what extent the winter injury in this section is responsible for the death of the trees is a question. In certain cases it was very evident that the trees had died from this cause." This statement shows that Whetzel recognized the importance of these winter injuries, though apparently he made a mistake in considering blight the major cause of the trouble.

Stone, of the Massachusetts Station (Report 20, p. 123), also says: "In previous reports attention has been called to some of these troubles, more particularly to the extensive winter killing which caused so much injury during the winter of 1903-04, at which time thousands of trees and shrubs were

severely affected, many having been dying slowly ever since. Besides the trees which are dying, there are many others which are in a very much weakened condition. Numerous oaks which were injured four years ago have died during the past three years, and some of these not yet dead are gradually becoming weaker. * * * Mention has previously been made in our reports of the condition of the red maples, many of which are now gradually dying, and the white and rock maples are suffering to a limited extent from the same cause." And in a later Report (23, p. 66) he adds: "The severe winter of 1903-04 was not confined to our state, as its work may be seen throughout the whole northeastern section of the United States, and in many instances large orchards were wiped out entirely."

The so-called pine blight was a trouble very prominent in New England a few years ago, culminating in its damage in 1907. At first some investigators, as well as growers, tried to show that this was a fungous trouble, but the investigations of Stone of Massachusetts, Morse of Maine, and of the writer, proved that it was entirely due to unusual seasonal conditions, prominent among which was winter injury. Concerning this trouble, Stone (Report 22, p. 65) writes: "The present pine blight dates back to the winter of 1902-03, when the conditions were such as to cause much injury to vegetation in general. The following winter, 1903-04, was even more severe in its effects on vegetation, and caused extensive root killing of many trees and shrubs. Pine, as well as other trees, in many cases was killed outright, but the injury to the pine was largely confined to the small roots or those less than three-sixteenths of an inch in diameter." Morse (Forester's Seventh Rept., Me., p. 24) also says: "Practically all of the so-called pine blight in Maine appeared in 1907 and 1908, and was coincident with the most destructive winter injury to fruit trees known in the state in the last hundred years."

In the spring of 1907 a late frost killed the immature leaves of the sycamore over a considerable area, as shown by von Schrenk and the writer. It is at this time of the year that the anthracnose fungus begins to be prominent, and the action of the frost was so similar to that of the fungus that several investigators, who apparently were not acquainted with the result of this frost, later laid the trouble entirely to the fungus.

And this has been the case with a number of investigators who have laid winter-injury troubles largely or entirely to the fungi which later became prominent on the winter-injured tissues. One of the first problems the writer had in Connecticut was to connect, as the cause, a Cytospora fungus found on cankered bark of apple trees. We did not know as much about winter injury then as now, and were using the agent that was most evident at the time of the investigation, which occurred some time after the winter-injured cankers were produced.

As to the relationship of winter injury to the chestnuts themselves, we have this statement by Murrill (45, p. 153), when he first began his investigations: "It is possible that the conspicuous ravages of the disease about New York City are largely due to the severe and prolonged winter of 1903-04, in which many trees of various kinds were killed or injured." Later, Murrill seemed to have given up this idea. Stone (Report 23, p. 57) also writes on this point: "The writer has been informed by one who has had some opportunity to observe this disease, that it appears to be less prevalent on high elevations than in the valleys. * * * It is, however, quite significant that the Connecticut Valley region should possess such a large amount of infection as compared with other sections. We have noticed for some time that there is a difference in the degree of winter killing occurring in valleys and high elevations in this state. By far a greater amount of winter killing of trees occurred in river valleys and on the lower elevations, the Connecticut Valley being especially notable in this respect. It is, moreover, a significant coincidence that the chestnut disease *should make its appearance at about the same time that vegetation* was so severely injured by the severe cold which occurred during the winter of 1903-04 all over the northeastern part of the United States."

From the preceding discussion we have made it evident that there was a general and severe injury of trees of various kinds, resulting especially from the winters of 1902-03 and 1903-04 in New England and New York. We believe that the same conditions would have been found true for at least New Jersey and eastern Pennsylvania, had observations been made there at that time. This winter injury took severest effect along the

Sound* and its contributory rivers, and was soon followed in all these regions by the outbreak of chestnut blight.

Merkel (32), just about a year after the blight was first noticed by him, states that 98 per cent. of the trees were then affected, and adds: "The disease was noticed with equal frequency upon young specimens in the nursery, upon sprouts that had sprung from stumps of trees cut down the previous year, on young vigorous trees thirty to forty feet high standing in deep, rich soil, and also upon the few survivors of the primeval forest with trunks twelve to fourteen feet in circumference." Such a destructive and indiscriminate attack in a single year is not the history of the blight in the later infected regions. To the writer it leads to but one conclusion, namely, that in those regions where the blight first appeared and was most severe the trees had suffered severely from winter injury, as this is the only agent we know of that acts in such a quick and thorough manner.

Drought Injury. There are a number of observers, like Metcalf and Collins, who claim that lack of moisture as affecting the vigor of the chestnut has nothing whatever to do with the spread of the blight, but that, on the other hand, it should show greater progress in moist seasons, since these favor spore development and infection. This idea is also expressed in the following statement by Murrill (46): "Dry summers and otherwise unfavorable conditions may delay the progress of the disease a few years, but not very long." If the fungus were a strictly parasitic species, the condition of whose host made no difference in its virulence, this would be true. The writer, however, holds that the reverse is really the truth, namely, that drought, by weakening the trees, has greatly increased the spread of the disease, and that moist years, while favoring spore production, increase the resistance of the trees, and thereby really lessen infection.

From 1907 to 1911 Connecticut, at least, had an unusual series of summers, with drought periods that caused serious damage to cultivated crops and forest trees in general. For trees alone, that of 1911 caused the most injury, since it was not only severe

*Hodson (28) wrote in 1908:—"A favorable feature in the situation is that so far the disease has done most damage in the vicinity of the sea."

in itself, but was a culmination of a period of dry summers. During this dry period blight has been most conspicuous in its development and spread in Connecticut, culminating in 1911 with by far the most frequent complaints of damage and spread to new localities. Its unusual prominence in 1911 was not confined to Connecticut, for according to Rane (57, p. 49), Metcalf wrote him: "During the past summer the disease has spread more than in all its previous history." As we have already stated, the winter and spring of 1912 were so wet that much of the depleted moisture was restored to the soil. As the result, the general aspect of fruit and forest trees, including chestnut, showed great improvement over 1911, and along with this came a more or less apparent let-up in the spread and severity of the blight.

The particular situation of the trees, according to our observations, often makes a big difference in the development of this disease. Those on the edge of the forest, specially on the southern exposure, have often showed the disease first and most severely. Isolated clumps of sprouts in the open are very susceptible. Forests that have been opened up by removal of trees, especially if on hillsides with southern exposure, are where we find the blight most prominent. Also we have sometimes found it bad in the lowlands. All these represent conditions where the trees suffer most from lack of moisture under continued severe drought.

We have especially in mind a forest in Middlebury on a hillside with southern exposure where the blight became very prevalent. There the trees unquestionably suffered severely from lack of moisture due to the droughts and the opening up of the forest by the removal of diseased trees. Many of those left finally showed sun-scald cankers with accompanying development of blight, at their base on the southern exposure, while the protected northern sides did not. Young nursery trees on this hillside also developed similar sun-scald cankers the first summer they were set out. While this part of the forest was being severely injured, trees on the northern exposure showed very little of the blight.

This observation agrees with the statement of Ashe (Tenn. Geol. Surv., 10 B, p. 11), who writes: "For many years the chestnut on the lower mountains in the southeastern portion of

the state has been dying out a few trees at a time. * * * Trees in the hollows and on cool north slopes and on land where a moderately dense shade and soil cover exist have not been affected. * * * The dying off of the trees is certainly not due to the chestnut bark disease." Local conditions such as outcrop of rocks, depth and character of soil, water table, presence of streams, exposure, etc., are all factors in the regulation of soil moisture,* and are not always easily determined by superficial examination. We do know that the blight often acts quite differently with these conditions varying in the same vicinity.

It is often hard to distinguish drought injury from winter injury, as trees that have suffered from severe droughts without much outward evidence of the trouble often succumb during the following winter, and winter injury is given the entire blame. This was well illustrated after the drought of 1911, by a number of fine large chestnut trees on the Experiment Station grounds. The drought of 1911, following the preceding dry years, was very hard on certain of these trees, as the rock in spots comes very close to the surface. The result was that, following the winter of 1911-12 they were seen to be very badly injured at their base, the dead bark in some cases almost entirely encircling the trees. On one tree this dead bark ran up the side for a considerable distance. A little of the blight fungus showed on these injured areas shortly afterward, but it was entirely a secondary factor.

There can be no question whatever that these droughts have injured various trees; and there is no getting around the fact that the blight has been more prevalent because of these droughts, and seems to have gotten the credit for injury to the chestnuts that is in part due to the droughts. Most persons admit that drought has injured and killed many trees other than the chestnut, yet are reluctant to concede that anything but the blight is responsible for the death of the latter. The injury by drought is well illustrated by the death of trees in

* We understand that, due to the installation of a large water reservoir in the southwestern part of Long Island, the water table of the surrounding region has been lowered considerably. This in turn has severely affected the forest trees, among which are many chestnuts. The blight is [illegible]

East Rock Park, New Haven. This rock rises to a considerable height above the surrounding country, and the soil in many places is quite shallow, so that the trees have suffered severely from lack of moisture during the dry years. The chestnut has suffered with the other trees, and the blight has developed conspicuously, killing many of them. Superintendent Amrhyn furnishes us with the following list of dead and dying trees that were found in this park in 1910.

"I herewith enclose a list of dead trees found in the East Rock Park forests in an inspection made during the month of August, 1910. You will find the largest percentage of them to be chestnut and hemlock. The first were not all dead, but were severely affected by the blight. The hemlocks are all dead, but a few of them have been in that state for two or three years, while all affected or dead chestnuts were cut down last winter.

Chestnut	1,362	Hickory	75	Beech	15
Hemlock	494	Maples	48	Elm	10
Oaks	271	Walnut	44	Linden	7
Birch	101	Wild cherry	24	Locust	4
Cedar	101	Ash	23	Sassafras	3
Carpinus	84	Pines	17	Apple	2

"I think that a very large percentage of these trees, 2,685, have died on account of the great dryness which has existed for about three years, changing conditions ever so much for the root systems of the trees."

Other investigators have admitted the connection between drought injury and blight infection, or at least the possibility of such connection, as shown by the following quotations:

Stone (Rept. 23, p. 57) says: "Our observations on the effects of meteorological conditions on vegetation, and the unusual opportunities we have had to study shade tree conditions for some years, have brought to our attention the unusually large amount of dead wood found on chestnut trees the past four or five years. From what we have seen of the chestnut during this period, we are of the opinion that it has not been in the best condition during late years, and that the chestnut, like the native white and black oaks, elms, red and rock maples, ash, etc., has been more or less affected by the severe cold and droughts of late years." A year later he writes further (Rept.

24, p. 78): "Like the preceding one, the past summer [1911] has been exceptionally dry, and the heat has been intense at times. This drought, coming as it did after three or four previous dry seasons, has affected vegetation to a considerable extent, and will result in later injury, especially to trees."

Rane (54, p. 152) said: "The disease was worse where thinnings had been made and a few trees allowed to stand because they were not large enough to cut into ties. These forests were unbalanced, and the air and sun allowed to get in. The blight was on the southern side; the cankers showed up largely there, but in the stands where we had normal conditions we found only a diseased tree once in a while."

Rankin (60, p. 47), in speaking of the relation of chestnut blight to drought, says: "Preliminary investigations carried on by the speaker seem to point to the fact that the susceptibility of the chestnut tree to this fungus depends upon drought conditions; that is, a low water content in the tree. * * * If the results of Doctor Moench on the cause of susceptibility and immunity of forest trees to disease should prove true in the case of this disease also, we may hope to be able to control the bark disease in shade, lawn and park trees by keeping up the water content of the tree."

Dr. Caroline Rumbold (63, p. 57) states: "As for water, there is the question, as to whether or not droughts of recent years are partially responsible for the spread of the disease in the chestnut tree. I am now conducting experiments in which chestnut trees are being exposed to infection under varying conditions, from dryness to excessive moisture, both atmospheric and soil. These experiments may also throw some light on the report that the blight spreads rapidly where trees are in a crowded coppice, while trees growing on the ridge of a hill are unaffected."

Fire Injury. Not only the writer, but other members of the Station staff, have repeatedly noticed the blight on trees injured by forest fires. Examination of the region has usually shown that the blight was much worse on the trees within the fire area than on those beyond it. This fungus, in the writer's opinion, has not developed merely because of mechanical injury to the tissues, but rather because of lowered vitality of the inner bark and cambium. S. W. Eddy of Avon, in March,

1912, sent us specimens of the blight, and wrote: "We are enclosing you sample of what we think is the chestnut blight. As about 50 per cent. of the trees that were burned by forest fires last spring are covered with this growth, we desire very much to learn whether or not this is the blight." Mr. Eddy, in February of the following year, reported that he found the fungus abundant on the cut wood and fire-injured trees, but scarce on the perfectly healthy ones.

Others have noticed this relationship of blight to fire injury, as shown by the following quotations. Rane (54, p. 152) says: "There is an unbalanced condition again where forest fires have run through the state year after year, and the trees are abnormal, and only half alive anyway. There you find the disease seems to travel more rapidly than it does where the trees are under normal conditions, and have a forest floor where there is plenty of moisture and the conditions are more favorable." Buttrick, in a paper on the effects of forest fires on the trees (Forestry Quarterly, Vol. 10, No. 2), also remarks: "*Diaporthe parasitica*, chestnut bark fungus, seems to be more abundant and severe on fire-injured trees."

Sprouts versus Seedlings. Much of the chestnut of Connecticut has been cut over two or three times, being renewed by sprout growth. This repeated cutting has occurred not only in Connecticut, and in the greater part of New England, but in the chestnut forests of New Jersey, Delaware, and the eastern parts of New York, Pennsylvania and Maryland. It is generally admitted that this treatment has reduced the vitality of the coppice growth, as shown by the following quotation from R. Zon on the chestnut in southern Maryland (U. S. Dept. Agr. Bur. For. Bull. 53, p. 29): "It must not be forgotten, however, that a chestnut stump cannot go on coppicing forever. With each new generation of sprouts, the stump becomes more and more weakened, and hence gradually loses its capacity to produce healthy and vigorous sprouts. Although it is impossible to state with certainty how many generations of chestnut can be raised from the same stock without impairing the vitality of the sprouts, the effects of repeated and bad coppicing manifest themselves in the increasing number of dying chestnuts all over Maryland. The immediate cause of their death can nearly always be traced to attacks of either insects or fungi, yet the

prime reason is their decreased vitality, which makes them easy prey to their natural enemies."

If the chestnut blight has no relation to the age or vigor of the tree, it is certainly a curious coincidence that the blight makes its first appearance and causes its greatest damage in the regions where the chestnut has suffered most from repeated cutting over. This is indicated by the two following statements.

Nellis, of the United States Forest Service, in an unpublished working plan on "Utilization of Blight-killed Chestnut," writes: "It is expected that this study will show that the present range of the chestnut bark disease is in a region of entirely second-growth chestnut, which has been culled of its most valuable timber, where only rough products are now being produced."

Barrus, of New York (54, p. 160), says: "In those sections of New York state where the chestnut disease is present most of the marketable timber has been cut out. Fire has gone through the remainder, and as a result, there is a great majority of the chestnut which is sprout growth of small dimensions. I should estimate that one-fifth of the chestnut is of merchantable size, and perhaps in the districts where the disease is, more than four-fifths is under merchantable size."

It has been our experience that young, especially isolated coppice growth, has suffered first and most severely in Connecticut. We believe that these sprouts are naturally weak and easily killed by drought, etc. On the other hand, very large seedling trees have been the last to go with the blight. We noticed also, in our inoculation work, that it was somewhat easier to infect sprout growth than young seedling trees, and that the cankers on sprouts developed more rapidly.

In June, 1912, we examined a field where the Ansonia Water Company had planted about seven bushels of chestnuts in 1908, in 1909 had set out 6,900 one-year seedlings, and in 1910, 9,875 two-year seedlings. While many of these seedlings had been killed by drought soon after they were set out, as shown by the vacant places, we were able to find only two seedlings that showed any signs of the blight fungus. Yet the woods surrounding these trees were quite badly infected with the blight.

At one of the Connecticut nurseries, however, in September, 1911, we inspected about three hundred five-year-old American

seedling chestnuts which had been transplanted when one year old, and found 46 per cent. infected with the blight, which had been present there at least two years, and probably started at the time of transplanting. The roots of these plants, when examined, were in good condition. We had the superintendent cut off all the diseased trees in one row (sixty-nine), and in February, 1913, the sprouts that had come from these showed only one that was plainly infected with blight, although they were exposed to the blight from infected seedlings that had not been removed. The first-year sprouts from old stumps also rarely show infection. According to our infection experiments, it usually takes only a month for the canker to show after inoculation, so these one-year-old sprouts had time to show the disease if they were infected. We believe the old, well-established roots produced unusually vigorous sprouts, which for the time being, at least, escaped infection.

Vitality versus Chemical Activity. We believe that favorable or unfavorable climatic conditions for a plant are recorded through chemical activities concerned with its growth and vigor, and that a lessening of this chemical activity might with some plants be shown by lessened resistance to fungous attack. The following few references show the relationship of environment on chemical activities of certain plants.

Hasselbring (Bot. Gaz. 53, p. 120) says: "It is true, of course, that plants are modified in their fluctuating characteristics by changes in the environment, but so far as experimental evidence shows, such modifications persist only as long as the environment inducing them persists. LeClerc and Leavitt, in their work with wheat, showed that this influence of the environment is exerted also on the chemical composition of plants. When wheat of one variety from one locality was grown in other localities with a widely different environment, the chemical composition of the grain was different in each locality. These differences persisted as long as the wheat was grown in the particular locality, but if at any time seed from one locality was grown in any of the others, the grain took on the composition of the wheat constantly grown in those localities.

Vasey (U. S. Dept. Agr. Rept. 1872, p. 171) mentions a case where the alkaloids of cinchona bark were decreased by unfavorable climatic conditions in the case of plants grown in England

as compared with plants grown in Peru. Yet when plants from England were sent to India, their vigor was restored, and an increase of the alkaloids was shown by chemical analysis, especially in the descendants of plants sent there.

McKenney (Science 31, p. 750) writes concerning the blight of Central American bananas: "The juice of diseased plants contains much less tannin than that of the normal plants. * * * It has been proved that the disease is not due to local conditions, such as too wet or too dry soil, etc. Yet some of these conditions may predispose the plants to the disease." He does not say whether the lessened tannic acid is the result of the disease or vice versa.

Tannic Acid and its Relationship to Chestnut Blight. The chestnut as a source of tannin is one of our most important trees. However, it seems that most of this tannin is made from the chestnuts in the South, although they are utilized as far north as Pennsylvania. The reason for this is that the chestnuts in the South furnish a greater percentage of tannin than those in the North. At least one cause for this seems to be that the older the trees the greater the percentage of tannic acid, since the tannin is made from the ground wood and apparently comes largely from the older wood. As a rule, the chestnuts of the South are much older than those of the North, and are more likely to be seedlings. As yet the chestnut blight has not caused much harm in the South. Whether or not the present of more tannic acid in the trees there has any relationship to the absence of the blight is as yet uncertain, but there is a possibility of its having a direct bearing.

In answer to a question regarding variation of tannic acid in chestnut trees, Mr. F. Veitch, of the Leather and Paper Laboratory of the United States Department of Agriculture, writes me as follows: "I have your letter of the 11th inst. asking for the tannin content of chestnut wood. This differs all the way from 2 per cent. to as high as 10 or 12 per cent. in very old, dry chestnut. The chestnut wood used by extract makers probably averages around 6 per cent. of tannin. I can make no more definite statement regarding the tannin content of any particular chestnut than to say that young chestnut as a rule contains the least, while the old chestnut contains the highest percentage of tannin. Only the body and large limbs

of the tree without the bark are used in the making of tannin extracts."

W. M. Benson (54, p. 229) makes a statement regarding chestnut trees grown on different soils which, if true, possibly explains why, in very dry years, the trees suffer more from the blight than in wet ones, since there may be some relation between the amount of moisture and lime taken in by the roots and tannin produced in the tree. He says: "The chestnut wood received at the extract factories was at first supposed to be all alike in tannin strength, but costly experience proved that wood from good strong lime shale or limestone lands is far richer in tannin than wood from soils that are rocky, sterile, and contain little lime. The difference is so marked that even the workmen in the leach house at extract plants can tell when wood from a lime shale or limestone region is being leached simply by the unusual increase in the strength of the liquid obtained from such wood. Chemical analyses proved the same thing beyond all question, that in order for chestnut timber to attain its full tannin strength it must grow on limestone or lime shale soil."

The part that tannin plays in the economy of plants is not very definitely known. It has generally been supposed to be largely a waste product, which serves more or less as a protective agent against animal and fungus attack. Some few writers have raised the question whether or not it might serve some use in the physiological activities of the plant, possibly in the way of food.

For instance, Pfeffer (Physiol. of Plants, 1, p. 491-3) says: 'Fungi can assimilate many aromatic bodies such as tannin, resorcin, hydroquinone, phloroglucin, etc., but except in the case of quinic acid most of these afford very poor food materials. * * *[3] Tannins, phloroglucin, and apparently all aromatic substances which accumulate to any extent, are contained in solution in the cell sap, so that their presence does not injuriously affect the protoplast. * * * Tannins and glucosides are undoubtedly produced for definite purposes, and are not mere by-products produced under all circumstances. * * * In spite of numerous recent researches, but little is known as to the function of tannin."

Barnes (Textbook of Botany, 1, p. 414) says concerning this subject: "Some substances, including the loose term tannin, are glucosides, and such as can be made to yield glucose by digestion may be considered as plastic substances rather than wastes." Stevens (Plant Anat., p. 205) also states: "Tannins seem to be by-products, set aside in the tannin cells from the general circulation. It is uncertain whether the tannins are ever used to an appreciable extent in nutrition. They seem to be of service, however, in warding off parasites by their aseptic qualities and astringent taste."

Cook (Delaware Agr. Exp. Sta. Bull. 91, p. 59), who studied the effect of tannic acid on different species of fungi in artificial cultures, says in his general summary: "It appears that tannin is an important factor, and that its importance varies in accordance with the other substances with which it is associated in the cells of the host plant. While tannin no doubt serves as a protective agent, its efficiency in this direction will vary somewhat with the character of the other substances within the cell. This may account for the variation in power of resistance between species, varieties, and individual plants. The fact that plants which produce large quantities of tannin are subject to disease is no argument against the preceding. The organism may live in tissues which bear little or no tannin, or which contain other substances that in a measure counteract the influence of the tannin. Furthermore, some species of fungi are much more resistant to tannin than are others, and the species which attack these high tannin-bearing plants no doubt possess this quality."

To the writer it has occurred that possibly tannin may serve as an unusual source of food for certain trees rich in this product under unfavorable conditions for active formation of their normal food supply, such as drought years, and that such a use would lessen the supply of tannin laid down in the annual growth of wood formed in these years. Or possibly if not used for food, these unusual conditions do not favor its normal production. In any case, if tannin content bears a relation to the blight disease, it is not the tannin of the whole tree that counts so much as the tannin of the bark and wood of that year's growth. If it bears any relation to the chemical activity

year to year according to external conditions more or less favorable for its production.

In our tannic acid culture work with the true chestnut blight and its close ally, *Endothia gyrosa,* reported in detail later on, we found: (1) Both fungi can use tannic acid, at least in small amounts, as food,—shown by the blackening of media through oxidation, loss of acidity, more luxuriant growth, with a low per cent. of the acid added, than without it, and a slight growth on agar-agar with tannic acid as the available source of food. (2) Higher percentages of tannic acid (four per cent. and above) are detrimental to a vigorous growth of either of these fungi, and finally (10 to 14 per cent.) entirely inhibit their growth. But with the true blight the tolerance is apparently greater by 2 to 4 per cent. than that of the saprophytic *E. gyrosa.* (3) Long-continued cultivation of the parasitic variety in artificial cultures without tannic acid probably lowers its tolerance to the higher percentages of tannic acid. (4) Gradually passing these fungi in cultures from the lower to the higher percentages of tannic acid apparently raises their tolerance to it.

From the results of these cultural experiments and what we have been able to learn about tannic acid in the chestnut, we reason that the true chestnut blight is better able to become an active parasite on chestnut trees than the *Endothia gyrosa.* Any cause that would lower the tannic acid, etc., content of the trees would allow it to develop into a more vigorous parasite, and its gradual tolerance to this higher percentage of tannic acid would give it an added virulence up to a certain extent. With the return of the tannic acid, etc., content of the tree above this limit of tolerance, the fungus would gradually revert to a less virulent and finally to even an inconspicuous parasite.

PREVIOUS CHESTNUT TROUBLES.

Nature of the Troubles. It is well known that in times past the chestnut trees in this country have suffered severely in certain districts, particularly in the South, in some cases being practically exterminated, so that their range is now considerably lessened from what it was originally. Strangely enough, no one has surely accounted for any of these devastations.

Personally we believe that this tree is extremely susceptible to changes in the natural environment, and that such changes, with water playing an important part, have been the chief factors back of the gradual decline of this important forest tree. Other factors, such as forest fires, deterioration through repeated cuttings, insect and fungus attacks, are contributing causes varying in different localities.

The question naturally arises, has the blight fungus had anything to do with these previous troubles of the chestnut? As no one ever made a careful study of them at the time, it is impossible to state whether or not the blight was connected with them. One thing is certain, and that is that the saprophytic *Endothia gyrosa* is so generally scattered over the South to-day that there is no doubt it occurred in the regions where these chestnut troubles existed. It seems almost equally certain that the real chestnut blight does not to-day occur in those regions, or if it does, it is very inconspicuous. This would seem to indicate that if the blight had anything to do with these troubles in the past it was not able afterwards to exist there, but gradually extended northward. When one reads the accounts of the outbreaks, he can easily imagine that the trouble might be due to the blight fungus. We give here, arranged according to the time of their occurrence, some references to these troubles.

1825-45. We quote the following from an article by Mr. Jones of Georgia, which appeared in the American Journal of Science, Vol. 1, p. 450, in 1846: "The present remarks are particularly directed to the death and disappearance of some of our trees and shrubs. The first that I will mention is the *Castanea pumila, which is a tree from ten to thirty feet in* height. In the year 1825, during the months from June to September, I observed this tree dying when in full leaf, and with fruit half matured. I examined numerous individuals, and could find no internal cause for their dying. I at first attributed it to the great fall of rain which took place in the year 1823. During the month of July of that year a considerable quantity of land not subject to overflow was covered with water for some time, and the highest lands were completely saturated. The latter part of 1824 was also very rainy. Knowing that this tree belongs in our highest and dryest soils, I concluded it was owing to a too moist state of the ground, but

since that time I am convinced that there must be some other cause, for the tree continues still to die up to the year 1845, *and if the disease is not arrested, in a few years I fear it will* be entirely exterminated."

1856. Following is a letter from Professor G. W. Hilgard, received October 25, 1909 (similar observations by him have been recorded by Dr. Rumbold in Science, Vol. 34, p. 917): "Your paper on the chestnut disease in New England reminds me of some old observations of mine made in the state of Mississippi in 1856. Traveling in the pine hills of northeastern Mississippi, I noted that of the small percentage of chestnut trees among the pines only a few were living, the great majority, mostly very large, tall trees, dead and decaying. On inquiry of the inhabitants, I found that this deadening had occurred lately, and they were at a loss to account for it. To my question why so many were charred at the base, the reply was that when the boys wanted to make a fire for nooning, they made it against these trees because they burned easily. The trees had not been killed in that way, but had died 'of their own account.' No other kind of trees seemed to be diseased. It was distinctly a dying off of the chestnut alone, and it extended far into Alabama. It would be interesting to know whether the results of that epidemic have been permanent, or whether a new growth has come since the time I saw it. If the Diaporthe disease existed in Mississippi, the presumption is that it extends or extended all along the western Alleghany slopes, and has perhaps reached the Atlantic Coast only recently"

1856. This note was found in The Horticulturist, 1856, p. 97: "All the chestnut trees throughout Rockingham County, North Carolina, and the surrounding counties have died this season."

1855-75. The following references are taken from an article on Statistics of Forestry in the U. S. Dept. Agr., 1875, p. 262, and are concerning chestnuts in the southern belt: "In several localities chestnut for some undiscovered reason appears to be *dying out.*" Under *notes on forestry conditions in Henry* County, Va., is the following statement: "Chestnut has been dying out for years, and there are fears that it will become extinct." Concerning Elbert County, Ga., is the following: "The forests are a mixture of almost all kinds, but chestnut during the last twenty years has nearly died out." Under

Carroll County, the same state, is the statement: "The forests contained a large quantity of chestnut, which began to die about ten years ago, and now scarcely a tree is left. Even the bushes are nearly all dead, though no insect or worm or other cause affecting them has been discovered." From Hall County also it is said: "Until within a few years chestnut abounded, but now nearly every tree is dead or dying." And from Walton County: "The chestnut has all died."

1847-77. Under Diseases of Chestnut, p. 116, A. S. Fuller, in The Nut Culturist, published in 1896, writes: "I have never noticed any special disease among chestnuts, neither do I find any mentioned in European books on forestry. The nearest approach to any such malady being recorded as having appeared in this country, is found in a paragraph in Hough's Report on Forestry, 1877, page 470, where the author copies from Professor W. C. Kerr, state geologist of North Carolina, as follows: 'The chestnut was formerly abundant in the Piedmont region down to the country between the Catawba and Yadkin rivers, but within the last thirty years they have mostly perished. They are now found east of the Blue Ridge only, on higher ridges and spurs of the mountains. They have suffered injury here, and are dying out both here and beyond the Blue Ridge. They are much less fruitful than they were a generation ago, and the crop is much more uncertain.' While there is nothing said about chestnut disease in the paragraph quoted, we only infer that the author intended to convey the idea that the trees were suffering from some endemic malady, although it may have been due to long droughts, insect depredators, or other causes. A few years later Mr. Hough, in his Elements of Forestry, refers to the subject again, and admits that 'the cause of the malady is unknown.' But as the chestnuts continue to come to our market in vast quantities from the Piedmont regions, there must be a goodly number of healthy trees remaining."

1889. On this date, P. H. Mell, in the Ala. Exp. Stat. Bull. 3, p. 16, says: "The trees [chestnut] of this state seem to be subject to a blight, or some destructive disease that is rapidly destroying them. This is particularly true when other trees are cut around them. This subject is worthy of careful investigation, and will be a problem for the experiment station to

solve in the future." Recently writing to Professor Mell regarding this trouble, he replied: "In reference to Bulletin 3 of the Alabama Experiment Station in regard to the disease which attacked the chestnut trees in Alabama during 1889, I do not think investigation was ever carefully carried out." Atkinson, former, and Wolf, present botanist, at the Auburn Station are unable to throw any additional light on this trouble.

1894. G. McCarthy, in N. Car. Exp. Stat. Bull. 105, p. 267, says concerning chestnut in this state: "The woodman's axe, casual fires, and the ravages of the root disease, have wrought much havoc with these grand forests."

—*1896.* W. P. Corsa, in Nut Culture in the United States, a special report of the U. S. Dept. Agr., Div. Pom., published in 1896, p. 78, writes: "From causes not well understood, there is a marked decline in the vigor of the chestnut throughout the broad area of territory in the Southern States where the white man found this tree among the most thrifty of the original forests. Down to the first quarter of the present century there seems to have been no mention of a trouble in the chestnuts of that section. Within the memory of residents of the Gulf States the chestnut flourished in all their higher lands. In point of time the trouble seems to have begun in the most southern limit of chestnut growth, and there the destruction has been most complete. It has pushed its encroachments throughout Mississippi, Alabama, Georgia, and South Carolina, and is now reported in the strongholds of chestnut growth in North Carolina, Tennessee and Virginia. Observation of the native chestnut growth of Maryland and Virginia discloses the fact that many trees are dying without apparent cause. In some sections this is attributed to the ravages of insects. In others, to an unknown disease resembling blight. There is need for a more thorough investigation of this subject than has yet been made. No injury to the Japanese or European chestnut planted in this country is yet reported."

—*1901.* Dr. Mohr, in Plant Life of Alabama, published by the U. S. Dept. of Agr., Div. Bot., in 1901, page 61, states: "The chestnut, usually one of the most frequent trees of these forests, is at present rarely found in perfection. The older trees mostly show signs of decay, and the seedlings, as well as the coppice growth proceeding from the stumps, are more or less

stunted. It is asserted by the old settlers that this tree is dying out all over the mountainous regions, where at the beginning of the second half of the century it was still abundant and in perfection."

—*1911*. W. W. Ashe, in Chestnut in Tennessee, Tenn. Geol. Surv. Bull. 10 B, p. 11, remarks: "For many years the chestnut in lower mountains in the southeastern portion of the state has been dying out a few trees at a time. * * * The dying off of the trees is certainly not due to the chestnut bark disease, a very destructive malady from Virginia to southern New England, no evidence of which was seen in Tennessee."

—*1912*. Dr. Hopkins (54, p. 180), of the United States Dept. of Agriculture, who has recently been making a study of the relationship of insects to the death of chestnut trees in the South, states: "When we review the history of the extensive dying of chestnut during the past half century in Mississippi, Tennessee, Georgia, South Carolina, North Carolina, and Virginia, it is surprising that there are any living trees left. In fact, there are not many left in some sections of these states, where the tree was abundant and healthy fifty years ago. It appears that there are a number of agencies of destruction other than the new chestnut blight disease, and that these agencies have been in operation in the area affected by the disease as well as in areas where this disease is not known to occur. Therefore, they must be taken into consideration and investigated before the problem of protecting the chestnuts can be solved. There appear to be other diseases, and we know that there are insects which have been directly or indirectly the cause of the death of a large percentage of the chestnuts over extensive areas."

—*1913*. Professor H. R. Fulton, of the Agricultural Experiment Station, West Raleigh, N. C., under date of January 29, 1913, writes: "Throughout the whole Piedmont section of this state, just as in the corresponding section of Virginia and further south, the chestnut trees are in an unthrifty condition. This is probably due to a combination of factors. Changes in soil conditions due to a clearing up of extensive areas probably play a part. Trees are evidently attacked to a considerable extent by borers and other insects. Fire injury has in many instances had something to do with the situation. Our preliminary survey

of the field has not disclosed any fungous disease that seems to be importantly connected with the condition of the trees."

NATIVE HOME OF THE FUNGUS.

General Considerations. Previous to the work of Merkel and Murrill, no one had ever, so far as known, collected or described the true chestnut blight fungus. Its sudden and destructive appearance naturally leads to the question,—Where did it come from? Murrill has not tried to solve this problem, although we understand he at first believed it to be a native species. The writer is the only one who, claiming it a native species, has attempted to give definite reasons for the belief, and an explanation of its sudden and aggressive development. Others have come forward with the suggestion that it is an introduced parasite, brought in accidentally, either from Japan or Europe. They have been led to their belief apparently largely because the blight was reported at first from a restricted region around New York City, and has apparently since then spread from this center into the regions in which it is now known. We shall consider in the following paragraphs each of these possible habitats for this fungus.

Japan. Metcalf has suggested most definitely that the fungus originally came from Japan, and Marlatt (31), following this suggestion, gives the blight as one of the most striking examples of "why we need a national law to prevent the importation of insect-infested and diseased plants." Metcalf's (33, p. 4) first statement concerning the native home of this fungus is as follows: "The immunity of the Japanese chestnut, together with the fact that it was first introduced and cultivated on Long Island and in the very locality from which the disease appears to have spread, suggests the interesting hypothesis that the disease was introduced from Japan. So far, however, no facts have been adduced to substantiate this view." Later, Metcalf and Collins (36, p. 46) say: "Investigations are in progress to determine the origin of the bark disease in America, and the details regarding its spread. The theory advanced in the previous publication of this Bureau that the Japanese chestnuts were the original source of infection has been strengthened by many facts. It lacks much of demonstration, however, and

is still advanced only tentatively. * * * Chester's Cytospora on a Japanese chestnut noted at Newark, Del., in 1902, may have been the bark disease."

Recently Metcalf (35, p. 222) remarks: "Its origin is unknown, but there is some evidence that it was imported from the Orient." Later, in answer to a direct question as to its origin, he adds (p. 227): "That is exactly what we would like to know more about. The fact that the disease has obviously spread from a center leads me to believe that it is an importation rather than a disease which has developed here. The fact that the locality from which it has spread is the same locality into which the Japanese chestnut was first extensively introduced, that the Japanese and Corean chestnuts are highly resistant, and are the only varieties that are at all resistant, all suggest the hypothesis that the fungus parasite may have come from the Orient. However, the origin of the parasite is not a matter of practical importance, unless it could be shown that the fungus parasite is developing spontaneously in many localities from some native saprophytic form, in which case the difficulties of control would be greatly increased."

In the preceding, Metcalf brings out four points in favor of the Japanese origin of the fungus, as follows: (1) Immunity of Japanese and Corean chestnuts; (2) Outbreak of disease originally in Long Island, where Japanese chestnuts were first imported; (3) Spread of the disease from a single center; (4) Possibility of Chester's Cytospora on Japanese chestnut being the blight fungus. Let us take up these four points for further consideration.

(1) The immunity of Japanese chestnut does not necessarily mean that this fungus occurred on it in Japan, and when brought to America spread to the American chestnut, and, finding it a more favorable host, caused the serious outbreak here, as Metcalf suggests. It may merely mean that the Japanese is a more hardy species. From the statements of Morris (13, p. 43) we take it that this is the case, since it is only the Japanese or Corean varieties from the more northern regions that show this resistance. Recently it has been found that the Japanese chestnut is highly resistant to the black canker, a serious chestnut disease now causing trouble in France. Arguing along Metcalf's theory, one could say that this French fungus was of probable Japanese

origin, which no one claims, so far as we know. Again, neither the chestnut blight fungus nor the closely related *Endothia gyrosa* has ever been reported from Japan, so far as the writer has been able to learn. In order to look into this matter a little more thoroughly, we wrote to three of the leading Japanese mycologists on this point. None of them could give us any information of the occurrence of these fungi there, or of any serious chestnut trouble that could be attributed to them. One of them naïvely answered: "Some botanists in your country seem to entertain the opinion that this chestnut blight fungus is of Japanese origin,—an apparently plausible opinion in accordance with a popular belief in certain quarters of your country that things obnoxious come from the other side of the Pacific. Let us see whether the words of these chestnut prophets prove to be the fact or not."

(2, 3) We have attempted, under the head "Manner of Distribution," to show that this disease did not originate in one locality, where first reported, and that its spread has not been from a single, but from many centers.

(4) Regarding Chester's Cytospora on Japanese chestnut, we can say definitely that this was not the blight fungus. We are indebted to the Delaware Experiment Station for the opportunity of examining the herbarium specimen of this, and we find that it is an entirely different fungus, being similar to a Phoma-like fungus not uncommon on dead and dying chestnut sprouts.

Europe. While Farlow (20, p. 70) was one of the first to call attention to the very close relationship, if not exact identity, of our chestnut blight with *Endothia gyrosa* as found in Europe, he has made no claim that the disease was introduced into this country fı

sitica, as at first supposed, really a species new to science? If so, is it a native species which has hitherto escaped the notice of all mycologists, or has it been introduced from some other country?" One can infer from his article, however, that if the fungus was proved to be an imported one he would favor Europe rather than Japan as being its native home.

Shear (65, p. 212), however, comes out with a more definite statement as regards the European origin of the fungus, as follows: "As a result of our studies to date, we are of the opinion that *Diaporthe parasitica* Murr. is the same as *Endothia*

radicalis of European authors, but not of Schweinitz, and that it was probably introduced into this country from Europe, and has gradually spread from the original points of introduction, its spread being facilitated chiefly by borers or other animal agencies which produced wounds favorable for infection by the fungus."

Shear's reason for supposing that the chestnut blight was imported from Europe was that *Endothia gyrosa* occurred on chestnut there, and he could not distinguish the American chestnut blight from this fungus. He, however, apparently did not know that *E. gyrosa* (*E. radicalis* of some European authors) also occurred on chestnut in this country. Further, he (66) was misled by an incorrectly named culture received from Pantanelli (supposed to be of European origin but later turning out to be the real blight from America) with which he produced the disease in chestnuts.

Pantanelli (53) of Italy, who has recently made a study of the European *Endothia gyrosa* and the American chestnut blight, finds (1) that they are different in many small microscopic characters; (2) that, while *E. gyrosa* varies somewhat in character in Europe, there are no variations that correspond to the chestnut blight type; (3) that the native *E. gyrosa* causes no serious disease in Europe; (4) that the American chestnut blight, when inoculated into chestnut in Italy, produces the disease. Naturally he concludes that our chestnut blight cannot be of European origin.

To the above we might add the fact that European chestnut grown in this country is quite susceptible to the blight, and it would be rather difficult to explain its susceptibility in this country and its immunity to the native fungus there, unless environment really did bear some relationship to susceptibility and immunity of the host, which is denied by Metcalf.

United States. The writer's reasons for believing the chestnut blight is native to this country may be summarized as follows: (1) It has never been found in any other country. (2) It is very closely related to *Endothia gyrosa*, apparently developing from it as a distinct variety, and this species is a native fungus in this country as well as in Europe. (3) The limits of distribution of *E. gyrosa* and the chestnut blight overlap at least in the region covered by Washington, D. C., to southern Pennsylvania,

while *E. gyrosa* occurs south of this common area and the chestnut blight north of it. (4) We have previously had serious troubles of chestnut trees in this country, and there seems to have been a continued northward movement of these, culminating in the recent trouble in the northern limit. While the chestnut blight has been definitely connected only with this last trouble, the previous ones have never been really explained. (5) The suddenness, etc., of the recent blight outbreak has been adequately explained by the writer through the unusual environmental conditions that have weakened the chestnuts in the general regions where the outbreak has occurred. (6) The fact that the chestnut blight fungus was never reported before this outbreak is no more difficult to explain than the fact that *E. gyrosa* had never been reported on chestnut in this country until by the writer a year ago, and yet this is a native fungus widely distributed on chestnut in the South, and has been known there on other hosts since 1822, when described by Schweinitz. They both were, in fact, merely overlooked on the chestnut. (7) Our cultures of *E. gyrosa* vary more from their normal type than do those of the variety *parasitica*, and some of these have varied somewhat toward the variety *parasitica* type. This, however, may have been due in part to bacterial contamination, etc.

AMERICAN SPECIES OF ENDOTHIA.

Various Species. It has been agreed among those who have recently studied the blight fungus from a systematic standpoint that it belongs under the genus Endothia rather than under Diaporthe, and is at least very closely related to the American-European species *Endothia gyrosa*. So far there have been described under the genus Endothia comparatively few species. Fries, who founded this genus, apparently considered *Sphaeria gyrosa* as the type, but did not give a very complete generic description. As understood to-day, however, Endothia has quite distinct generic characters. Of the species other than *Endothia gyrosa* and the chestnut blight, there have been found in North America *Endothia Parryi* (Farl.) Cke., on Agave sp., *Endothia longirostrata* Earle, on the bark of fallen trees from Porto Rico, and *Endothia radicalis* (Schw.) Farl., on Quercus, etc., chiefly from the Southern states.

Besides these, there is a somewhat similar appearing fungus recently described, by H. & P. Sydow (Ann. Myc. 10, p. 82) on Quercus from Colorado, as *Calopactis singularis.* It is a semi-parasitic species, apparently, whose generic position is somewhat doubtful, as the asco-stage has not been found. It has been known in this country for some time, and by some botanists has been placed under *Endothia gyrosa,* since the fruiting pustules and the Cytospora spores of the two are very similar. However, the fruiting pustules are larger, deeper crimson in color, and in maturity more powdery. We have it in culture from a specimen recently sent by Bethel from Colorado, and while it grows something like *E. gyrosa,* it does not form any distinct conidial fruiting pustules on media tried so far, and in manner of growth and color of mycelium resembles more nearly the cultures of *E. radicalis.*

Of the species mentioned, we need to consider in connection with the blight fungus only *Endothia gyrosa,* already discussed somewhat, and *Endothia radicalis,* since these three in their Cytospora stage are so similar in appearance that they cannot be distinguished by the naked eye, and all have at least the oak as a common host. As *E. radicalis* is most sharply set off from the other two, we will discuss it first.

Endothia radicalis. While the fruiting pustules of this species are not different from the other two, when we examine the asco-stage under the microscope it is very easily distinguished by the much narrower spores. These ascospores vary from linear to linear-oblong, are occasionally slightly curved, are apparently single-celled, though possibly they may in some cases develop an indistinct septum, and are 6-10 μ, rarely 12 μ, long by 1-2 μ wide. We have never seen spores which grade into those of the other two species described here, so it is apparently quite a distinct species. See Plate XXVIII a, d.

It seems to be largely southern, having been found in its asco-stage in Louisiana, Mississippi, Georgia, Alabama, Florida and North and South Carolina. However, there are specimens in various herbaria from much further north, showing only the conidial stage, that apparently belong to this species. One specimen found in Connecticut has been under observation on roots of an oak tree for over a year, and though in a vigorous growing condition has made no attempt to form the asco-stage

Artificial cultures, however, show that it is this species. This means, apparently, that the species does not form its asco-stage readily in the North. It has not been reported as yet from Europe or elsewhere. While it seems to be largely saprophytic, we recently received from Wolf, of Auburn, Ala., an elegant specimen on the live trunk of water oak, that shows it possesses parasitic tendencies. Plate XXIV e.

So far this fungus has been reported on several species of Quercus and on *Liquidambar Styraciflua*. Earle and Underwood collected what may be this species on Vitis. Schweinitz described his *Sphaeria radicalis* as rare on roots of Fagus, though on the envelope containing the original specimen he states it is on the roots of Quercus, which seems more likely. However, we have recently received ample specimens collected by Hall, at Clemson College, S. C., on the roots and bark of Fagus, which proves that this is to-day a host of the fungus further south, and so it may have been at Salem, N. C., as stated by Schweinitz.

In cultures it forms a rather abundant aerial mycelium, something like *Endothia gyrosa*, but differs in that this is much more fluffy in character, and does not usually form fruiting pustules on the surface of the agar, Plate XXVI 7596. The conidial spores are produced in rather indefinite spots on the mycelium, and are very similar in appearance to those of the other two species, Plate XXVIII g-i. The mycelium lacks the *bright* orange color that is characteristic of *Endothia gyrosa* on most media. At first it is white, and often remains partly uncolored, but finally has considerable *brownish* orange color, especially next the glass on the surface of the agar. In Petrie dishes the mycelium often forms a somewhat annulated development by the newer growth being less elevated than the older. We have cultures of it from *Liquidambar Stryraciflua* and *Quercus nigra*, from Alabama; *Fagus ferruginea*, *Quercus coccinea*, and Quercus sp., from South Carolina; *Quercus falcata*, from North Carolina; and *Quercus rubra*, from Connecticut.

There is considerable doubt as to who first described this species, since it has usually been confused with the next. Shear (64) speaks of it as *Endothia radicalis* (Schw.), thus identifying it with *Sphaeria radicalis* of Schweinitz; and the Andersons seem to think that Shear definitely proved it to be identical

with that species. No Schweinitzian specimens of *Sphaeria radicalis* in this country, however, have yet been found which have ascospores, though there is no doubt from the specimen in the conidial stage in the Schweinitzian collection in the Philadelphia Academy of Science that *S. radicalis* refers either to this species or to *E. gyrosa*. As Shear had opportunity to see certain specimens of *S. radicalis* and *S. gyrosa* sent by Schweinitz to European botanists, the writer thought he had found the ascospores of *S. radicalis* to be linear. Recently writing Shear on this point, we received the following letter:

"The specimens on oak roots collected by Hall in South Carolina which I identified as the typical *S. radicalis* of Schweinitz were, according to my recollection, compared with authentic specimens of Schweinitz from either Schweinitz's herbarium or Curtis' herbarium at Harvard. This identification was made last winter before my trip to Europe. I have been going over carefully all our slides and specimens to locate the material on which this identification was based. I regret to say that thus far I have been unable to find it. In this same connection I have examined very carefully the material from the Kew herbarium, which consists of an autograph specimen collected by Schweinitz, presumably at Salem, N. C., and sent by him to Hooker. I am surprised to find, on examination, that this specimen, though it shows considerable variation in ascospore measurements, does not appear to agree with the long, slender form of ascospores found in the specimen on oak roots which I sent you from Hall's collection at Clemson College, S. C. The measurements, as they have just been made from a slide from the Kew specimen, range mostly from 6.3-8.6 by 2.8-3.6 μ. I think it is still possible that all sorts of intermediate forms and sizes of spores will be found in the South connecting the long and short-spored specimens."

Writing to the Kew herbarium for information concerning the specimen mentioned by Shear, which seems to be the only Schweinitzian ascospore specimen of *Sphaeria radicalis* yet reported, we received a letter from Assistant Director Hill, with he following notes made by E. M. Wakefield: "The specimen eferred to by Shear appears to be one which bears simply a asted-on rough paper label with the name '*Sphaeria radicalis*'

here at present, the handwriting is that of Schwaegrichen, and the specimen is an authentic Schweinitzian one. It is probably one of a set sent to Hooker, though there is nothing on the label to indicate that this was the case. There is a pencil reference in another handwriting (apparently Berkeley's) to 'Fr El. 2 p. 73. Versatiles.' Some ascospores have been found in this specimen from which the accompanying drawing has been made. They measure 5-7.5 x 2-3 μ (average size about 7 x 2 μ). The spores are usually one-septate. The septa are indistinct unless stained."

From Shear's and Wakefield's measurements of the spores, one can readily see that the specimen in the Kew herbarium labeled *Sphaeria radicalis* is not the species we are considering here under that name, but really the next species, *Endothia gyrosa.* In a previous publication (9) we stated our belief that Schweinitz's *S. radicalis* and *S. gyrosa* represented either the two distinct species of Endothia that we now find in the southern United States or else the conidial and the asco-stage of only one of them, most likely *S. gyrosa.* This Kew specimen points to the latter of these two conclusions. It has also been the opinion of certain European botanists that these two species of Schweinitz were merely synonyms, and identical with the form found in Europe, which we call *Endothia gyrosa.*

Ellis (N. Am. Pyren. p. 552) in his description included both of these species (his spore measurements relating to one and his drawings to the other), though most of the specimens he referred to are those with linear spores. Farlow (20) was the first to really point out the two as distinct species, and because of this we (9) previously referred to the linear-spored form as *Endothia radicalis* (Schw.) Farl., though Farlow never definitely used this combination for the fungus. While at present it seems somewhat doubtful if Schweinitz's *Sphaeria radicalis* really relates to this fungus, we shall retain this combination, hoping for further light on the subject through future investigation. On the other hand, there is little if any doubt that Schweinitz's *Pesiza cinnabarina* does relate to its conidial stage, since it is identical, and has Liquidambar for a host, a host upon which *E. gyrosa* has not yet been reported. The nomenclature already used for this fungus by different writers is as follows:

Endothia radicalis (Schw.?) Farl.

Peziza flammea Schw. (not Alb. & Schw.) in Fung. Car. Sup. n. 1193. 1822.

Peziza cinnabarina Schw. N. A. Fung. n. 840. 1831.

? *Sphaeria radicalis* Schw. N. A. Fung. n. 1269. 1831.

Sphaeria gyrosa Schw., Ravenel in Fung. Car. n. 49. 1852.

Lachnella cinnabarina Sacc. Syll. Fung. 8: 399. 1889.

Endothia gyrosa (Schw.), Ell. & Ev. in N. A. Pyren.: 552. 1892. *p. p.*

Endothia radicalis (Schw.), Shear in Phytop. 2: 88. Ap. 1912.

Endothia radicalis (Schw.) Fr., Andersons in Phytop. 2: 210. O. 1912.

Endothia radicalis (Schw.) Farl., Clinton in Science 36: 910. D. 1912.

Endothia gyrosa. We have examined ascospore specimens of this species on *Castanea dentata* from several southern states; on *Castanea sativa* from two sources in Italy; on *Quercus alba, Q. velutina,* Quercus sps. from several localities in America; on Quercus sp. from Italy; on *Carpinus Betulus* from Tiflis, Russia; on Carpinus sp. from Italy. So far as we can tell from a microscopic examination, these all belong to the same species, though there is some slight variation of the ascospores in the different specimens. These ascospores vary from elliptical oblong to narrowly oval, often tapering to one or both ends, have an evident septum, and are chiefly 6-9 μ long x 2-3.5 μ wide. They are therefore quite distinct from those of the preceding species (see Plate XXVIII b, e). Saccardo gives Aesculus, Alnus, Corylus, Fagus, Juglans and Ulmus as reported hosts for this species, with a distribution including North America, Europe, Ceylon, and New Zealand. But a careful comparative examination would be necessary to state positively that these all relate to the same fungus.

We have made cultures of this fungus from many different sources on chestnut and oak from the South, and on chestnut from Italy. See Plate XXVI 7590, 7584. While these show some slight variations, they have a general agreement, but differ decidedly from all cultures of the true chestnut blight. We have made inoculation tests, and have found the fungus

to be a saprophyte, but with weak parasitic tendencies. Both the cultures and the inoculations we will discuss later in connection with those of the true chestnut blight.

From the name usually applied, *Endothia gyrosa* (Schw.) Fr., it is seen that Schweinitz's *Sphaeria gyrosa* is considered the original type of the species. Schweinitz, in his Fung. Car. Sup., 1822, described this from Salem, N. C., on decaying bark of knots and also living bark of Fagus and Juglans. There is to-day some doubt about his correct determination of these hosts. He sent specimens to Fries, who also described it in his Syst. Myc. 2, p. 419, in 1823; and in his Elench. Fung. 2, p. 84, in 1828, he compares it with specimens received from Southern Europe. In 1845, Fries, in Summ. Veg. Scand., created a new genus, Endothia, citing *S. gyrosa* of Schweinitz as the type, and ever since then European botanists have considered *Endothia gyrosa* of Europe to be the same fungus as *Sphaeria gyrosa*, described by Schweinitz from America. Some few have given Fuckel as a second authority for the name, *E. gyrosa* (Schw.) Fckl., since that author in his Sym. Myc. p. 226, in 1869, indicated that he was the first to place this species under this genus, evidently considering that Fries had not properly placed it there, since he did not really write the combination *Endothia gyrosa*.

From the descriptions of both Schweinitz and Fries, it looks as if Schweinitz collected only the Cytospora stage of this fungus. This is further borne out by the fact that Schweinitzian specimens examined by Farlow and Shear in this country and Europe show only that stage. The original specimen of Schweinitz at the Philadelphia Academy of Science has been lost or misplaced, and in the original envelope is an entirely different fungus, a Nectria sent by Torrey from New England, which Schweinitz years afterwards apparently mistook to be this species. The writer (10) found a misplaced specimen (in another collection made by Schweinitz, now at the Philadelphia Academy of Science), which probably is his original type, but this also shows only the conidial stage. In the Curtis collection at Harvard, however, there is a Schweinitzian specimen of *S. gyrosa* which, while in the conidial stage, has a drawing on the envelope by Curtis of ascospores which are like those of this

species rather than linear, like those of *E. radicalis*, already discussed.

Both Schweinitz and Fries always considered *Sphaeria gyrosa* and *S. radicalis* as distinct species, but of very similar appearance, and Fries, when he formed the genus Endothia, did not include the latter under it. Botanists in their day, however, did not make very careful microscopic examinations. De Notaris, in Sfer. Ital. 1^1, p. 91, in 1863, seems to have been the first to place *S. radicalis* under the genus Endothia, and Tulasne, in Sel. Fung. Carp. 2, p. 87 and p. 298, the same year, was apparently the first to consider the *S. gyrosa* and *S. radicalis* as one species, which he called *Melogramma gyrosa*. Fuckel also, in 1869, treated them as one species, and since that time European botanists have generally considered them as a single species, using sometimes *E. gyrosa* and sometimes *E. radicalis* as a specific name. In view of the information already given in Shear's letter, we are inclined to believe that this interpretation is correct, and that *S. gyrosa* is merely the conidial stage, as first suggested by Winter in Rab. Krypt. Fl. 1^2, p. 804.

A considerable number of names have been applied in Europe to *Endothia gyrosa*, but it is rather difficult to determine whether all of these apply to the fungus under discussion. For instance, Streinz, in Nom. Fung., p. 545, in 1862, under *S. gyrosa*, gives *S. fluens* Sow. as a synonym, and under *S. radicalis*, p. 559, gives *S. tuberculariae* Rud. as another. Shear has examined the Sowerby specimen, and he says: "There is little doubt that *Sphaeria fluens* Sow., described and figured by Sowerby in the supplement of his English Fungi, 1814, Plate 420, published as part of Plate 438, from a collection by Charles Lyall, in the New Forest of southern England, is the pycnidial condition of *Endothia radicalis* De Not." If this is true, then it must be an extremely rare fungus in England, since in answer to a letter to the Kew herbarium we received the reply that "*Endothia gyrosa* is very rare in Britain, if it really occurs." From Sowerby's description, one cannot be sure if it relates to this or some other fungus. Mr. Wakefield of Kew writes concerning our inquiry as to the host: "It is not possible to say with certainty what is the host of Sowerby's *Sphaeria fluens*. The specimen is very small, and no note is attached to it." We do

identified as the same thing as *Endothia gyrosa.* We give below the nomenclature which probably applies to the fungus in question.

Endothia gyrosa (Schw.) Fr.

- *? Sphaeria fluens* Sow. Eng. Fung. *t. 438* (with *t. 420*). 1809?
- *Sphaeria gyrosa* Schw.* Fung. Car. Sup. n. 24. 1822.
- *Sphaeria Tuberculariae,* Rudolphi in Linnaea 4: 393. 1829.
- *? Sphaeria radicalis* Schw.† N. A. Fung. n. 1269. 1831.
- *Endothia gyrosa* Fr. Summ. Veg. Scand.: 385. 1845.
- *Diatrype radicalis* Mont. Ann. Sci. Nat. Bot. 3: 123. 1855.
- *Valsa radicalis* Ces. & De Not. Schem. Sfer. Ital.: 33. 1863.
- *Endothia radicalis* De Not. Sfer. Ital. 1^1: 9. 1863.
- *Melogramma gyrosum* Tul. Sel. Fung. Carp. 2: 87. 1863.
- *Nectria gyrosa* B. & Br.‡ Journ. Linn. Soc. Bot. 15: 86. 1877.
- *Chryphonectria gyrosa* Sacc.‡ Syll. Fung. 17: 784. 1905.
- *Endothiella gyrosa* Sacc. Ann. Myc. 4: 273. 1906.
- *Endothia virginiana* Anders. Phytop. 2: 261. D. 1912.

Endothia gyrosa var. *parasitica.* We have previously spoken of the very close connection of *Endothia gyrosa* to the chestnut blight, and have shown that Farlow and Shear in this country, and von Höhnel, Saccardo and Rehm in Europe recognize them morphologically as a single species. Recently we sent ascospore specimens of the two on chestnuts from this country to these European botanists for further comparison, and their opinion as to the relationship. They still maintained that the American chestnut blight was not different specifically from *E. gyrosa* as found in Europe and America, but was merely a more luxuriant strain that had so developed through its parasitic habit. It is to be remembered, however, that all of the above investigators, except Shear, have based their conclusions merely on microscopic examination, since they have not had opportunity to study the situation in the field, and have not made cultures or inoculation experiments. On the other hand, it is to be taken

* The conidial stage of the fungus described.

† The [illegible] stage of the fungus described. Fries apparently published

into consideration that they are all botanists with a very extended experience in the systematic study of fungi.

The Andersons have taken the other extreme, namely, that the chestnut blight, which they call *Endothia parasitica*, is entirely a distinct species from *E. gyrosa*, which they call *E. virginiana*. Their conclusion is evidently based on the parasitic habit of the former as compared with the saprophytic habit of the latter, the difference between the two in artificial cultures, and the slight morphological differences in their ascospores. Pantanelli (53) in his recent article might be considered as agreeing with the Andersons in considering the two as distinct species, since in his conclusions he says: "The *Diaporthe parasitica* Murrill is an Endothia, closely related to, but not like, the *E. radicalis* (Schw.) Fr. Hence it is opportune to distinguish it as *E. parasitica* (Murr.) Anderson." However, Pantanelli was trying to show that these two were not entirely identical, and was not really concerned in their exact relationship, since he stated earlier in a footnote: "Recently, November 28, 1912, Professor P. A. Saccardo has communicated to me that he regards *E. parasitica* as a race of *E. radicalis* modified by parasitism. One may then consider whether it is a species or a distinct variety, but from the viewpoint of the pathologist it makes no difference."

The writer, after a careful study of the blight fungus and of *Endothia gyrosa*, microscopically, in cultures, and in inoculation experiments, with an opportunity to examine both in the field, and also specimens of *E. gyrosa* on several hosts from Europe, has come to the conclusion that these two forms are too closely related to be considered distinct species. On the other hand, they are certainly distinguished through slight morphological differences in their ascospores, marked and constant cultural differences, and the apparently great difference in their parasitic tendencies. These differences lead us to consider the blight fungus as a distinct variety of *E. gyrosa*, which is evidently the older form from which the blight fungus has been derived.

As previously stated, neither *Endothia radicalis* nor *E. gyrosa* and its variety *parasitica* differ enough in their fruiting pustules or conidial spores to present any very special distin-

differ from both the latter by being decidedly narrower (see Plate XXVIII a-c). The ascospores of *E. gyrosa* are much nearer to the type of the true blight fungus than to *E. radicalis*, although they are somewhat intermediate. In general we can describe the ascospores of *E. radicalis* as linear, those of *E. gyrosa* as narrowly oval, and those of *E. gyrosa* var. *parasitica* as broadly oval. Usually one finds some spores of *E. gyrosa* and the variety *parasitica* that cannot be distinguished in size or shape. However, upon examining many from a specimen, one can tell which it is, as *E. gyrosa* has some spores that are narrower, and variety *parasitica* some that are broader, than any found in the other form.

Measurements were made of one hundred ascospores of *Endothia gyrosa* var. *parasitica* from ten different chestnut trees from various localities, and these varied from 6 to 10 μ long x 2.75 to 5 μ wide, while the average was 7.45 μ long x 3.2 μ wide. Similarly, one hundred ascospores of *E. gyrosa* from ten different chestnut trees from various localities, including one from Europe, varied from 6 to 9 μ long x 2 to 3.5 μ wide, the average being 7.205 μ long x 2.695 μ wide. To have maintained the same proportion in width as in length to var. *parasitica*, these spores should have been 3.095 μ wide. Likewise, sixty ascospores of *E. gyrosa* on six oak trees from different localities, one from Europe, showed a variation of 6-9 μ x 2-3.25 μ, averaging 7.099 μ x 2.733 μ. Also forty ascospores of *E. gyrosa* on Carpinus from two sources in Europe varied from 5 to 10 μ x 2.25-3.5 μ, averaging 7.58 μ x 2.8 μ.

These measurements show that there is a rather constant difference in the width of the ascospores of *Endothia gyrosa* and *E. gyrosa* var. *parasitica*, no matter what the host or the locality from which they came, and if we also take into consideration the differences in artificial cultures and in the parasitic habits of the two, there seems no reason for not considering the blight fungus at least a distinct variety. The nomenclature of this variety is as follows:

Endothia gyrosa var. parasitica (Murr.) Clint.

Diaporthe parasitica Murr. Torreya 6: 189. 1906.

Valsonectria parasitica Rehm, Ann. Myc. 5: 210. 1907

Endothia parasitica Anders. Phytop. 2: 262. D. 1912.

ARTIFICIAL CULTURES.

Source of Cultures, etc. We have had cultures of *Endothia gyrosa* under observation for more than a year, and of the variety *parasitica* for more than four years. These have been obtained from many different localities, and from both chestnut and oak in each case. For example, we now have eighteen different cultures of the chestnut blight obtained from localities in Massachusetts, Connecticut, New York, Pennsylvania, and the District of Columbia; and besides these we have had others from time to time. We have five cultures of the blight originally obtained from three different species of oak, from two regions in Connecticut and one in Pennsylvania. Of *E. gyrosa* on chestnut we have fifteen cultures from eight different regions in Pennsylvania, Virginia, Tennessee, and North Carolina, and one from Europe; and ten cultures from three species of oak from five different regions in the District of Columbia, Virginia, and North Carolina.

We have grown many hundreds of these cultures on a variety of media in test tubes and Petrie dishes, though for most purposes tubes of potato- or oat-juice agar have proved the most satisfactory. From this extended experience we have been able to judge accurately as to purity of the cultures, constancy of their cultural characteristics, and differences that distinguish the variety from the species. Ordinarily the conidial spores of each have regularly appeared in these cultures, but in varying degree. In no case has the asco-stage of either been produced. Its production has seemed more likely to occur in the case of *Endothia gyrosa,* since in some cultures the conidial fruiting stage appeared as rather large, distinct, elevated pustules; but these have never shown any signs of ascospore formation. We have made some attempts, by special media or treatment, to induce the asco-stage to appear in these pustules, but without success.

Endothia gyrosa versus var. parasitica. The following characteristic differences were noted in special test tube cultures made at the same time on potato-, Lima bean-, and oat-juice agar, from twenty-five sources of *Endothia gyrosa* and ten sources of var. *parasitica.* In general, it may be stated that the

oat-juice agar favors a vigorous aerial mycelial development, especially for *E. gyrosa*. The bean-juice agar is somewhat intermediate in both respects. On any of these media, *E. gyrosa* is much less likely to exude spore masses in abundance than the variety *parasitica*. Perhaps this accounts for the ease with which the variety propagates itself in nature. The chief cultural differences of the two are as follows:

(1) Var. *parasitica* fruits more abundantly, and exudes the sticky spore masses much more conspicuously, than does *Endothia gyrosa*. (2) The variety fruits earlier than the species, as determined by the exuding spore drops. (3) The variety has less evident, smaller, or more embedded fruiting bodies than the species, in which they are often elevated, distinct pustules, rarely hidden by the exuding spore mass. (4) The species develops a much more luxuriant aerial mycelium (except possibly on potato agar) than does the variety. (5) The species has its aerial mycelium more generally and more highly orange colored, especially on oat-juice agar, than does the variety.

The more minute and variable differences of the two on the three media are as follows: On the potato-juice agar var. *parasitica* forms chiefly an embedded growth, which, while white at first, soon becomes rather deeply colored, and produces numerous obscure or embedded fruiting bodies, which exude small, colored, sticky spore drops rather thickly over the surface of the agar. Finally, a slight surface growth of a flavus mycelium sometimes develops. The species differs in having at first a slightly more evident growth of mycelium, and finally having usually fewer, but larger, spore masses. The color of the embedded growth is variable, usually darker than in the variety, sometimes blackish, as if from bacterial contamination, but possibly due to variation in the composition of the medium.

On the Lima bean-juice agar var. *parasitica* produces fewer, but larger, fruiting bodies and spore drops than on the potato-juice agar, while its aerial mycelium is more evident, and varies from albus to sulphureus in color. The species makes a much more evident aerial growth than the variety, while its fruiting pustules are decidedly fewer, larger, more elevated and distinct, and exude spores less abundantly. The color is much more evident than in the variety, though variable even in the same tube,

aurantiacus-miniatus on the edges where it is in contact with glass or medium.

On oat-juice agar the variety *parasitica* forms a somewhat more evident aerial mycelium, but has fewer pustules and less evident spore drops even than on the Lima bean-juice agar. It usually has a deeper color, which varies from albus to luteus. The species on oat-juice agar forms a very luxuriant growth, even more so than on Lima bean-juice agar, and though its fruiting bodies are not so numerous, they are often evident exposed pustules, only partially hidden by the spores mass, which exudes with difficulty. The color assumes its maximum development and is in strong contrast to that of the variety on the same medium. It is usually more uniform and intense in color than on the bean-juice agar, finally varying from luteus through aurantiacus to miniatus and even badius when in contact with the glass or medium. Part of the growth, especially on the upper edge, however, often remains albus.

The color of the spore masses of both forms varies in different cultures from sulphureus to nearly purpureus, depending apparently on age, variation of the medium, bacterial contamination, or other unknown factors. Likewise, a culture when renewed on the same medium sometimes acts somewhat differently for some unknown reason, as to luxuriance in mycelial growth or spore development, or color characters.

Tannic Acid in Cultures. Since tannin is found in such large quantities in the wood of chestnut, and since this varies according to the age of the tree, etc., it has been suggested previously in this paper that this variation may have some bearing upon the development of the chestnut blight. It was thought desirable, therefore, to study both the saprophytic *Endothia gyrosa* and the variety *parasitica* in artificial cultures containing different percentages of tannic acid (M. C. W. brand, U. S. P.) to determine how this affected their vigor, growth and spore production. These cultures have all been made by Mr. Stoddard under the writer's direction, and the data here given should be credited to both investigators. We have used mainly for this work two rather recent cultures of *E. gyrosa* on two species of oak from Washington, D. C., and four cultures of *E. gyrosa* var. *parasitica* on chestnut, two from Washington and two from

Per cent. of Tannin.	Result.	Endothia gyrosa Quercus sp.	Endothia gyrosa Quercus velutina.	E. gyrosa var. parasitica Castanea dentata.	E. gyrosa var. parasitica Castanea dentata.	E. gyrosa var. parasitica Castanea dentata.	E. gyrosa var. parasitica Castanea dentata.
4%	Grew...	5	8	8	8	7	5
	Failed..	3	0	0	0	1	3
4.8%	Grew...	6	6	7	8	7	7
	Failed..	2	2	1	0	1	1
6%	Grew...	7	5	5	7	8	7
	Failed..	1	3	3	1	0	1
8%	Grew...	4	4	6	4	4	4
	Failed..	4	4	2	4	4	4
10%	Grew...	0	2	3	3	4	6
	Failed..	8	6	5	5	4	2
10.5%	Grew...	1	0	6	4	5	5
	Failed..	7	8	2	4	3	3
11%	Grew...	2	1	8	4	5	3
	Failed..	6	7	0	4	3	5
11.5%	Grew...	1	1	5	5	4	5
	Failed..	7	7	3	3	4	3
12%	Grew...	2	2	5	6	5	5
	Failed..	6	6	3	2	3	3
14%	Grew...	0	0	1	0	0	0
	Failed..	8	8	7	8	8	8
Total No.	Grew...	28	29	56	49	49	48
	Failed..	52	51	24	31	31	32
Total %	Grew...	35%	36%	70%	61%	61%	60%
	Failed..	65%	64%	30%	39%	39%	40%

Connecticut. Of these four, three had been in culture only a few months, while one had been in culture over three years.

In each test we made three cultures of each of the above for duplication. We grew these on plain potato-juice agar, as checks for comparison, and also on this medium to which had been added the following percentages of tannic acid: 0.2, 0.4, 0.8, 1.2, 1.6, 2.4, 3.2, 4.0, 4.8, 6.0, 8.0, 10.0, 10.5, 11.0, 11.5, 12.0, 14.0; see Plate XXVII. These cultures were first made in 1912, and repeated in 1913 for confirmation, this time using five cultures of each in each test. The table shows the results of all these cultures in the tubes containing 4% or more of tannic acid. Those containing lower per cents. all grew, and so are omitted in the table. From the results of these investigations we obtained the following information:

(1) The growth of either fungus causes no darkening of the plain potato-juice agar, but when tannic acid is added, even as

low as 0.2 per cent. in case of var. *parasitica,* the growth of the fungus causes a darkening of the medium. This indicates an oxidation of the tannic acid by the fungus, since these tubes without the introduction of the fungus remain undarkened except with the higher percentages, when they color as soon as made, upon cooling. With *E. gyrosa,* this darkening scarcely takes place, and with var. *parasitica* is less evident in those tubes containing only 0.2 and 0.4 per cent. of tannic acid, but shows on all strengths above these with both fungi about the same, though appearing sooner with var. *parasitica.*

(2) The medium in the tannic acid tubes remains liquefied when 0.8 per cent. or more tannic acid is added. The acidity of potato-juice agar and, in the lower percentages, of tannic acid potato-juice agar, where darkening of the medium does not interfere, can be tested before and after growth of these fungi by titrating with $\frac{N}{20}$ Na O H, using phenolphthalein as an indicator. These tests show that after *E. gyrosa* or var. *parasitica* has fully developed in plain potato-juice agar the acidity is practically unchanged; but in tannic acid potato-juice agar both of these fungi cause a lowering in the acidity of the medium, and the higher the acidity usually the greater the loss, though not proportionately greater, as shown by the following tests:

Tannic Acid added (per cent.).	Acid Test before inoculation.	Acid Test after growth.	Loss in Acidity.
0.0	0.15 cc. $\frac{N}{20}$ Na O H	0.15 cc. $\frac{N}{20}$ Na O H	0.0
0.2	.9 " " " " "	0.4 " " " " "	0.5
0.4	1.2 " " " " "	0.85 " " " " "	0.35
0.8	1.8 " " " " "	... " " " " "	...
1.2	2.1 " " " " "	1.4 " " " " "	0.7
1.6	2.7 " " " " "	1.8 " " " " "	0.9

(3) Cultures of *E. gyrosa* var. *parasitica* containing 0.2, 0.4, 0.8 per cent. tannic acid show a more vigorous spore development than the check cultures of potato-juice agar without tannic acid. The same was true of *E. gyrosa* regarding mycelial development, but to a less extent, and possibly also as to spore development, though with this fungus the spores do not exude very abundantly in any case.

(4) At about 4 per cent. the loss in color, especially with *E.*

4 per cent. tannic acid, the growth of the fungi tends to form a more or less firm coating over the surface, after the manner of growth on the solid medium. Above 4 per cent. the growth becomes gradually less evident, generally showing in floating patches, embedded masses, or lateral growths around the side of the glass. Finally, at the highest percentages, 10 to 14, growth entirely ceases, only one having been successful at the latter strength in any of the tubes.

(5) In the higher percentages of tannic acid *E. gyrosa* shows an enfeebled growth sooner than does var. *parasitica*, since at 6 to 8 per cent. it makes comparatively little growth, corresponding to that made by the variety at about 10 per cent. It generally fails entirely to make any growth at above 10 per cent., or only a poor growth above 8 per cent. in most of the tubes; while the variety in only one case made any growth above 12 per cent. and rarely any but a poor growth above 10 per cent.

(6) At the higher percentages the difference in the appearance of the two fungi is less marked than at the lower, so that from 4 per cent. up, where spore production of the variety is largely cut out, they are scarcely to be distinguished.

(7) There was some variation in development with the different cultures of the same fungus in the higher percentages of the tannic acid, as shown by one of the cultures of var. *parasitica* from Connecticut which had been in artificial culture for over three years failing to grow quite as well as the more recent cultures. These variations are perhaps not constant.

(8) All the preceding notes relate to cultures that were inoculated from plain potato-juice agar directly onto those containing various percentages of tannic acid. Another set of cultures was made in which each was brought up gradually through all the lower percentages of tannic acid. In these it was found that this gradual acclimatization to the tannic acid gave a somewhat more luxuriant growth of both fungi at the higher percentages than when transferred directly from the potato-juice agar to these.

Later experiments based on the preceding results were made with all our cultures of *E. gyrosa* (26 in number) and those of var. *parasitica* (22 in number), using two cultures of each and the following percentages of tannic acid: 4.0, 6.0, 8.0, 10.0.

parasitica will grow in higher per cents. of tannic acid and give a more evident development of mycelium than *E. gyrosa*. The details of this experiment are given in the appended table.

Per cent. of Tannin.	Name.	Grew.					Total.		Failed.	
		Good.	Fair.	Poor.	Slight.	Very Slight.	No.	Per cent.	No.	Per cent.
4%	Endothia gyrosa.............	6	15	10	0	0	31	59.6	21	40.4
	E. gyrosa var. parasitica......	18	23	2	0	0	43	97.6	1	2.4
6%	Endothia gyrosa.............	1	15	9	2	4	31	59.6	21	40.4
	E. gyrosa var. parasitica......	29	13	3	0	0	44	100.0	0	0.0
8%	Endothia gyrosa.............	0	0	9	13	7	29	55.7	23	44.3
	E. gyrosa var. parasitica......	15	14	5	3	0	37	84.1	7	15.9
10%	Endothia gyrosa.............	0	0	0	20	6	26	50.0	26	50.0
	Endothia gyrosa var. parasitica	2	15	8	13	0	38	86.3	6	13.7

INOCULATION EXPERIMENTS.

General Conditions, etc. These experiments were undertaken primarily to determine the parasitic tendency of *Endothia gyrosa* as compared with that of the variety *parasitica*. That the latter could produce cankers when inoculated into chestnuts had been abundantly proved by the work of Murrill and others. With most of our inoculations both the species and the variety were used at the same time, and checks were also included. Nearly all these inoculations were made from artificial cultures, and usually only with conidial spores. Ordinarily a small slit in the bark was made with a sharp scalpel, spores from the cultures were introduced on a needle, the wound covered with moist cotton, and then bound with paraffine paper or bicycle tape. After several weeks the covering was removed. The checks were treated in the same way, except that no spores were introduced into the wound.

In this way there were inoculated two- to three-year-old seedling chestnuts, four- or five-year-old chestnut sprouts, and two-year seedling oak at the Station Farm at Mount Carmel; six- to eight-year-old slow-growing chestnut seedlings at the Station forestry plantation at Rainbow; and two- to four-year-old oak sprouts in a waste lot at Highwood. The tables which

that apparently enter into their success that we had not in mind when the experiments were undertaken, namely:—length of time the fungus has been in artificial cultivation, age of the particular spores used, and time of year of the inoculation. This makes it difficult to judge of the results of certain of these inoculations, since two or more of these factors may have been involved. The final results of our inoculations were determined about the second week in October. Of course this gave some of the earlier inoculations made in May a much longer time to develop than those made in July, although these latter had plenty of time to show whether or not they were successful. We will consider the results briefly under the following headings.

Endothia gyrosa versus var. parasitica. Ordinarily it takes about a month to determine whether or not an inoculation has taken, and even then it is sometimes doubtful, since the tissues around the wound often die back for a short distance as the result of the mechanical injury. The sum total of our experiments brings out quite clearly the difference in the parasitic nature of these two fungi. For instance, 151 out of all of our 324 inoculations with var. *parasitica,* from all sources on all hosts, produced more or less evident cankers, that is, 47 per cent. were successful; while of the 148 similar inoculations with *E. gyrosa* only 2 took, or about 1 per cent. Of these two, one showed only a comparatively small dead area, with fruiting pustules, around the point of inoculation, but did not seem to continue its growth, while the other was on a dead seedling whose roots had been cut off by mice, which no doubt weakened it, allowing the fungus to make an excellent growth, and even to produce its ascospores. If we take into consideration only our inoculations of var. *parasitica* originally obtained from chestnut and inoculated into chestnut sprouts and seedlings, we find that out of 232 inoculations 132, or 57 per cent., took, as compared with entire failure of *E. gyrosa* under the same conditions. None of the 228 check trees in all our experiments showed any signs of infection, thus proving that the wounding alone was not harmful when protected from infection.

With the check trees the cutting usually killed a little bark on either side, especially if the knife was run under between the bark and the wood. This never grew larger, and the callus

the wounds inoculated with *E. gyrosa*, sometimes this injured bark was a little more extensive than with the checks, which indicated a slight but futile attempt at parasitism. Occasionally, on this dead bark and exposed wood, a slight fruiting growth of the fungus as a saprophyte was formed.

With var. *parasitica*, however, the bark was gradually killed in an increasing area surrounding the point of inoculation, and this had a more or less irregular outline, spreading faster in some directions than in others. Eventually the whole stem or limb was encircled, if the inoculation was made early in the season (see Plate XXV a). At the inoculation point a callus of young tissue often developed, and the vitality of this was greater than that of the older tissues, since it often remained healthy, until, being entirely surrounded by dead tissues, it died as much from adverse nutritive conditions as from the direct action of the fungus (Plate XXV b).

After the cankers attained some size, their reddish dead bark often became cracked, and the Cytospora fruiting stage appeared in more or less abundance. An examination of the inoculations as late as the last of December, however, failed to show that the asco-stage had developed on any of them. Whether this means that ordinarily the mature fruiting stage does not appear until the second season, we do not know, but it shows that sometimes this is the case. The inoculations made early in May on the chestnut sprouts one to two inches in diameter entirely girdled these for six to eight inches, forming very evident cankers, but not always with a conspicuous development of conidial spores.

Hosts Inoculated. In the inoculation tests we used seedlings and sprouts of both chestnuts and oaks. Considering first only the chestnut hosts, we found that, as a rule, the variety *parasitica* could be more easily inoculated into the sprouts than into the seedlings, and that on the sprouts the blight made a larger growth in the same length of time. This greater development might in part be due to the larger size of the sprouts, which varied from about one-half to one and one-half inches in diameter, while the seedlings were only about one-quarter to three-quarters of an inch in diameter. Out of a total of 177 inoculations with cultures originally from chestnut made on

41 successful out of a total of 55, or 75 per cent., on the sprouts. An attempt to inoculate a young Japanese chestnut six inches in diameter failed entirely, although sixteen inoculations were made at two different periods. This seems to show that the tree had great resistance, if not immunity, to the disease.

As regards inoculation of chestnut, versus oaks, it was found that the former were much more readily infected than the latter, which showed only 12 successful infections out of 51, or 23 per cent. All of these were confined to the sprouts, and did not make nearly so vigorous growth as did the inoculations on chestnut sprouts. The oak seedlings used were rather small, and the inoculations were made comparatively late, using cultures obtained originally from both oak and chestnut.

Source of Cultures. Most of our inoculations were made with cultures obtained from chestnut, as at the time we had only one culture of var. *parasitica* from oak, namely *Quercus velutina* from Woodmont, Pa. This was inoculated into both chestnut and oak seedlings and sprouts. The inoculations into chestnut seedlings showed 4 successful out of 25, or about 15 per cent., while the 16 made on the chestnut sprouts all apparently failed, for some not very evident reason, possibly because made in July with old spores. Of the 20 inoculations on oak seedlings, all failed, while of the 12 on oak sprouts, 5, or 42 per cent., took more or less vigorously. From the results of the inoculations with this single culture, it would seem that the strain from oak at least was not quite so active a parasite as that from the chestnut itself.

Whether or not cultures from chestnuts from different regions, or from living as compared with dead trees, show any difference in virulence, we are not certain. In our experiments we did not get any conclusive results along this line. To determine these points accurately, however, one would need cultures that had only recently been obtained from their hosts, and whose spores when used were comparatively young and of the same age.

Age of Cultures. It seems quite probable that the longer the variety *parasitica* is kept in culture the more likely it is to lose, at least in part, its virulence. While no direct experiments were made to determine this point, it is possibly shown by the cul-

Hom.	Locality.	Culture obtained.	Age of Spores.	Cult. No.	Date Inoc.	Place.	Host Inoc.	Protection.	No. of Inoc.	Failed. %	Failed. No.	Very doubtful.	Took slightly.	Took well.
dent.	Phila., Pa.	18 Ap., '12	43	7004[1]	June 4	Greenh.	C. dent. sdl.[1]	Paper	6	33	2	0	0	4
dent.	Phila., Pa.	18 Ap., '12	43	7004[1]	June 4	Greenh.	C. dent. sdl.[2]	Paper	6	33	2	0	0	4
dent.	Phila., Pa.	18 Ap., '12	43	7004[1]	June 4	Greenh.	Q. alba 2[a]	Paper	2	100	2	0	0	0
......	....	....	..	......	June 4	Greenh.	C. dent. sdl. 2[a]	Paper	2	100	2	0	0	0
dent.	Wash'n, D. C.	2 Ja., '12	55	6758a[2]	May 9	Rainb.	C. dent. sdl.[3]	Paper	10	40	4	0	2	4
dent.	Wash'n, D. C.	2 Ja., '12	55	6757a[2]	May 9	Rainb.	C. dent. sdl.[4]	Tape	10	0	0	0	0	10
dent.	N. Lond., Ct.	4 O., '11	55	6527a[2]	May 9	Rainb.	C. dent. sdl.	Paper	10	50	5	0	1	4
cren.	Westr., Ct.	4 Au., '09	55	6594a[1]	May 9	Rainb.	C. dent. sdl.	Tape	10	50	5	0	0	5
alba	Wash'n, D. C.	2 Ja., '12	64	6891	May 9	Rainb.	C. dent. sdl.	Paper	8	100?	5	3	0	0
ier. sp.	Wash'n, D. C.	2 Ja., '12	55	6753a[1]	May 9	Rainb.	C. dent. sdl.[4]	Paper	8	100	8	0	0	0
ier. sp.	Wash'n, D. C.	2 Ja., '12	64	6899	May 9	Rainb.	C. dent. sdl.[4]	Tape	8	100	8	0	0	0
ier. sp.	Wash'n, D. C.	2 Ja., '12	55	6753a[2]	May 9	Rainb.	C. dent. sdl.	Tape	8	100	8	0	0	0
......	....	....	..	......	May 9	Rainb.	C. dent. sdl.	Paper	16	100	16	0	0	0
......	....	....	..	......	May 9	Rainb.	C. dent. sdl.	Tape	16	100	16	0	0	0
dent.	Phila., Pa.	18 Ap., '12	31	7004[2]	May 23	Station	C. cren.	Uncov.	8	100	8	0	0	0
dent.	Merid., Ct.	22 Jl., '12	19	7284[3]	Aug. 13	Station	C. cren.[4]	Tape	8	100	8	0	0	0
dent.	Wash'n, D. C.	2 Ja., '12	28	7092[2]	June 25	Mt. Car.	C. dent. sdl.[5]	Paper	25	24	6	0	0	19
velut.	Wash'n, D. C.	2 Ja., '12	102	6756a[2]	June 25	Mt. Car.	C. dent. sdl.[6]	Paper	20	95	19	0	0	1
......	....	....	..	......	June 25	Mt. Car.	C. dent. sdl.[5]	Paper	10	100	10	0	0	0
dent.	Wash'n, D. C.	2 Ja., '12	28	7092[1]	June 25	Mt. Car.	C. dent. sdl.[6]	Paper	25	4	1	0	3	21
ier. sp.	Wash'n, D. C.	2 Ja., '12	102	6753a[3]	June 25	Mt. Car.	C. dent. sdl.[6]	Paper	15	100	15	0	0	0
......	....	....	..	......	June 25	Mt. Car.	C. dent. sdl.[6]	Paper	10	100	10	0	0	0
velut.	Woodm., Pa.	18 Ap., '12	79	7002[1]	July 10	Mt. Car.	C. dent. sdl.	Tape	15	87?	12	1	2	0
velut.	Woodm., Pa.	18 Ap., '12	79	7002[1]	July 10	Mt. Car.	C. dent. sdl.[7]	Tape	10	80	8	0	1	1
......	....	....	..	......	July 10	Mt. Car.	C. dent. sdl.	Tape	5	100	5	0	0	0
......	....	....	..	......	July 10	Mt. Car.	C. dent. sdl.[8]	Tape	10	100	10	0	0	0
dent.	Wash'n, D. C.	2 Ja., '12	84	6985[1]	July 10	Mt. Car.	C. dent. sdl.[4]	Tape	10	70	7	0	1	2
dent.	Wash'n, D. C.	2 Ja., '12	84	6985[1]	July 10	Mt. Car.	C. dent. sdl.[7]	Tape	10	100	10	0	0	0
......	....	....	..	......	July 10	Mt. Car.	C. dent. sdl.	Tape	10	100	10	0	0	0
dent.	Brist., Ct.	24 Fe., '11	250	6598[3]	July 10	Mt. Car.	C. dent. sdl.	Tape	10	90	9	0	0	1
dent.	Brist., Ct.	24 Fe., '11	250	6598[3]	July 10	Mt. Car.	C. dent. sdl.[7]	Tape	10	100?	9	1	0	0
......	....	....	..	......	July 10	Mt. Car.	C. dent. sdl.	Tape	10	100	10	0	0	0
ier. sp.	Tryon, N. C.	24 Ap., '12	81	7016[2]	July 10	Mt. Car.	C. dent. sdl.	Tape	5	100	5	0	0	0

dent.	Con'lsv., Pa.	18 Ap., '12	79	7003[2]	July 10	Mt. Car.	C. dent. sdl.[1]	Tape	10	100	10	0	0	0
dent.	Wash'n, D. C.	2 Ja., '12	84	6985[1]	July 10	Mt. Car.	C. dent. sdl.[4]	Uncov.	10	100	10	0	0	0
......	....	....	..	......	July 10	Mt. Car.	C. dent. sdl.	Uncov.	10	100	10	0	0	0
dent.	Phila., Pa.	18 Ap., '12	84	7004[1]	July 15	Mt. Car.	C. dent. sdl.	Tape	5	100	5	0	0	0
dent.	Mt. Car., Ct.	Fresh Cytospora	spores	......	July 15	Mt. Car.	C. dent. sdl.	Tape	10	60	6	0	2	2
dent.	Mt. Car., Ct.	Fresh ascospore	s	......	July 15	Mt. Car.	C. dent. sdl.	Tape	10	40	4	0	1	5
dent.	Woodbr., Ct.	3 Fe., '11	28	7090[1]	June 25	Mt. Car.	C. dent. spr.	Paper	8	0	0	0	0	8
velut.	Wash'n, D. C.	2 Ja., '12	84	6756f[2]	June 25	Mt. Car.	C. dent. spr.	Paper	4	75?	1	2	1	0
......	....	....	..	......	June 25	Mt. Car.	C. dent. spr.	Paper	4	100	4	0	0	0
dent.	Woodbr., Ct.	3 Fe., '11	251	6599[3]	July 11	Mt. Car.	C. dent. spr.	Tape	4	50	2	0	0	2
velut.	Woodm., Pa.	18 Ap., '12	80	7002[1]	July 11	Mt. Car.	C. dent. spr.[7]	Tape	16	100?	15?	1	0	0
dent.	Con'lsv., Pa.	18 Ap., '12	80	7003[2]	July 11	Mt. Car.	C. dent. spr.	Tape	14	100?	12	2	0	0
dent.	Bicks'g, Va.	27 Fe., '12	85	6979[2]	July 11	Mt. Car.	C. dent. spr.	Tape	4	100	4	0	0	0
dent.	Phila., Pa.	18 Ap., '12	84	7004[1]	July 15	Mt. Car.	C. dent. spr.	Tape	5	40?	1	1	0	3
dent.	Phila., Pa.	18 Ap., '12	84	7004[1]	July 15	Mt. Car.	C. dent. spr.[7]	Tape	10	80	8	0	0	2
dent.	Mt. Car., Ct.	Fresh Cytospora	spores	......	July 15	Mt. Car.	C. dent. spr.	Tape	10	20	2	0	1	7
dent.	Mt. Car., Ct.	Fresh Cytospora	spores	......	July 15	Mt. Car.	C. dent. spr.[7]	Tape	18	0	0	0	0	18
velut.	Woodm., Pa.	18 Ap., '12	81	7002[1]	July 12	Mt. Car.	Q. rubra sdl.	Tape	10	100	10	0	0	0
velut.	Woodm., Pa.	18 Ap., '12	81	7002[1]	July 12	Mt. Car.	Q. rubra sdl.[9]	Uncov.	10	100	10	0	0	0
......	....	....	..	......	July 12	Mt. Car.	Q. rubra sdl.	Tape	5	100	5	0	0	0
......	....	....	..	......	July 12	Mt. Car.	Q. rubra sdl.[10]	Uncov.	5	100	5	0	0	0
dent.	Phila., Pa.	18 Ap., '12	81	7004[1]	July 12	Mt. Car.	Q. rubra sdl.	Tape	10	100	10	0	0	0
dent.	Bicks'g, Va.	27 Fe., '12	86	6979[2]	July 12	Mt. Car.	Q. rubra sdl.	Tape	5	100	5	0	0	0
ier. sp.	Tryon, N. C.	24 Ap., '12	74	7016[2]	July 12	Mt. Car.	Q. rubra sdl.	Tape	5	100	5	0	0	0
......	....	....	..	......	July 12	Mt. Car.	Q. rubra sdl.	Tape	5	100	5	0	0	0
dent.	Westv., Ct.	23 My., '12	33	7103[2]	July 3	Highw.	Q. alba spr.	Tape	2	0	0	0	0	2
dent.	Westv., Ct.	23 My., '12	33	7103[2]	July 3	Highw.	Q. alba spr.[7]	Tape	2	0	0	0	0	2
velut.	Woodm., Pa.	18 Ap., '12	44	7066	July 3	Highw.	Q. alba spr.	Tape	4	50	2	0	2	0
velut.	Woodm., Pa.	18 Ap., '12	44	7066	July 3	Highw.	Q. alba spr.[7]	Tape	4	75	3	0	0	1
alba.	Wash'n, D. C.	2 Ja., '12	76	6992[1]	July 3	Highw.	Q. alba spr.	Tape	2	100	2	0	0	0
alba.	Wash'n, D. C.	2 Ja., '12	76	6992[1]	July 3	Highw.	Q. alba spr.[7]	Tape	2	100	2	0	0	0
ier. sp.	Tryon, N. C.	24 Ap., '12	65	7016[1]	July 3	Highw.	Q. alba spr.	Tape	4	100	4	0	0	0
ier. sp.	Tryon, N. C.	24 Ap., '12	65	7016[1]	July 3	Highw.	Q. alba spr.[7]	Tape	4	100	4	0	0	0
dent.	Westv., Ct.	23 My., '12	33	7103[2]	July 3	Highw.	Quer. sp. spr.	Tape	1	0	0	0	1	0
dent.	Westv., Ct.	23 My., '12	33	7103[2]	July 3	Highw.	Quer. sp. spr.[7]	Tape	2	0	0	0	2	0
velut.	Woodm., Pa.	18 Ap., '12	44	7066	July 3	Highw.	Quer. sp. spr.	Tape	2	50	1	0	0	1
velut.	Woodm., Pa.	18 Ap., '12	44	7066	July 3	Highw.	Quer. sp. spr.[7]	Tape	2	50	1	0	1	0
alba	Wash'n, D. C.	2 Ja., '12	76	6992[1]	July 3	Highw.	Quer. sp. spr.	Tape	1	100	1	0	0	0

CONDENSED RESULTS OF INOCULATIONS WITH ENDOTHIA GYROSA AND ENDOTHIA GYROSA PARASITICA.

	Inoc. (No.)	Failed (No.)	Took (No.)	Took %
E. g. parasitica from Cast. on Cast. dent. seedl. ..	177	86	91	51
" " " " " " " " sprts. ..	55	14	41	75
" " " " " " Quer. sp. seedl. ..	12	12	0	0
" " " " " " " " sprts. ..	7	0	7	100
" " " " Querc. on Cast. dent. seedl. ..	25	21	4	16
" " " " " " " " sprts. ..	16	16[11]	0	0
" " " " " " Quer. sps. seedl. ..	20	20	0	0
" " " " " " " " sprts. ..	12	7	5	42
E. gyrosa " Cast. on Cast. dent. seedl. ..	15	15	0	0
" " " " " " " sprts. ..	18	18	0	0
" " " " " Quer. sps. seedl. ..	5	5	0	0
" " " " " " " sprts. ..	0	0	0	0
" " " Querc. on Cast. dent. seedl. ..	82	81	1	1
" " " " " " " sprts. ..	4	3	1	25
" " " " " Quer. sp. seedl. ..	5	5	0	0
" " " " " " " sprts. ..	19	19	0	0
Checks........................ on all Castanea..	113	113	0	0
Checks........................ on all *Quercus* ..	15	15	0	0

[1] Kept moist. [2] Kept dry. [1-2] One dry, one moist. [3] Culture originally from conidial spores. [4] Culture from ascospores. [5] Trees ridged to produce drought conditions. [6] Trees unridged. [7] Inoculated above and below knife girdle. [8] Cut above and below knife girdle, but not inoculated. [9] Stem inoculated underground. [10] Stem cut underground, but not inoculated. [11] If done earlier in the season, possibly some would have taken. These footnotes apply chiefly to large table; see column "Host Inoc." for numbers.

on August 4, 1909, which produced only 50 per cent. infection as against 100 per cent. produced by a culture over two years younger obtained from Washington, D. C., on January, 2, 1912. Both of these were of the same spore age, and inoculated into chestnut seedlings at the same time and place.

That the age of the spores used affects their virulence is apparently shown in a number of our inoculations. We used spores from cultures that had been made all the way from 20 to 100 days, in a few cases even 250 days. These spores were always somewhat moist when used, and though possibly some of them were too old to germinate, there must have been others that were not, since we have renewed cultures not infrequently that were 100 days old, and in one case a culture that was 399 days

the spores the higher the percentage of infection. For instance, on chestnut seedlings, cultures varying from 28 to 55 days old gave successful inoculations varying from 100 to 50 per cent.; while those 79 to 250 days old gave from 30 to 0 per cent. However, with the latter the time of inoculation may have entered into the problem, since in no case did we try to inoculate on the same date with spores of greatly different ages.

Time of Inoculation. Inoculations made in the spring are more successful than those made in midsummer, at least those we made in the spring were, as a rule, much more successful than those we made in July. However, as just stated, those made in the spring were made with younger spores than those made later, and just how much of the failure of the latter was due to the time of inoculation and how much to the age of the spores could not be determined. We have also tried inoculations on dormant seedlings in the greenhouse, and these have either failed to take or took only after the trees began to grow. The length of time the fungus has been in culture, age of the spores used, time of year the inoculation is made, are all points that need further investigation to bring out their bearings more clearly.

Condition of Host. We tried several experiments to determine what effect the condition of the host had on the success of the infection. These experiments included a few plants kept unusually wet and others very dry, in the greenhouse; others severely ridged outdoors to aid in drought conditions, compared with plants not ridged; and plants with knife cuts encircling the bark (in some cases with a band of bark removed) which were inoculated above and below these injured places. The results were rather conflicting, so that we could not tell whether or not these treatments made any special difference. Inasmuch as they did not show more striking evidence in favor of increased blight development under unfavorable conditions of the host, perhaps they may be interpreted as rather against, than in favor of, our theory that the condition of the host affects the prominence of the fungus as a parasite. However, such experiments need to be made in greater number and during

PREVENTIVE EXPERIMENTS.

Earlier Experiments. Murrill tried to control the chestnut disease, when it was first discovered at the New York Botanical Garden, by cutting down and destroying the badly infected trees and by cutting out cankers on those less seriously injured. He found this did not prevent its further spread. Writing in 1908, he (48) says: "Preventive measures have apparently not affected it in the slightest degree. Pruning of diseased branches has evidently failed to check it even in the case of very young trees. Branches have been carefully removed, and wounds covered, leaving trees apparently entirely sound, but upon inspection a few weeks or a few months later, they would be found badly diseased at other points." Merkel, at the New York Zoological Park, also tried to control the trouble by cutting down the badly infected trees and by spraying with Bordeaux mixture, but little or no benefit resulted from his efforts.

Metcalf undertook experiments to control the trouble on Long Island in a region where it was very bad. In 1909 he and Collins (36) say: "At present it is impossible definitely to record general beneficial results from any of the sprayings which have been undertaken or have been under observation. This may in part be due to the fact that it is yet too early to judge satisfactorily of the results, and in part perhaps to the infrequency of sprayings. * * * Almost the only treatment that can at present be safely recommended as surely retarding the spread of the disease, to a greater or less extent, is one which will never be of practical use except in the case of orchard trees or certain valuable ornamental trees. It consists essentially in cutting out the infected branches or areas of bark and carefully protecting the cut surfaces from outside infection by means of a coat of paint or tar. This cutting must be thoroughly done and the bark of every infected place entirely removed for a distance of at least an inch (when the size of the branch permits) beyond the characteristic, often fan-shaped, discolored area produced by the growing fungus in the inner bark." In a later report, they also advocate that when the inner bark is badly infected "at least two or three annual layers of wood beneath the diseased bark must also be gouged out."

Later Experiments. In a bulletin published in October 1911

bark disease, in those regions or states where it has not yet obtained a serious foothold, by means of quarantine and cutting out all diseased trees. This recommendation was based on the results of some experiments carried on in the vicinity of Washington, D. C., concerning which they write as follows:

"Fortunately, however, there is a method of dealing with the situation which is applicable to the country as a whole and which, so far as tested, is practicable. Early in the course of the writers' investigations it became evident that the disease advances but slowly in a solid line, but instead spreads from isolated centers of infection often many miles in advance of the main line of disease. * * * It therefore seems probable that if these advance infections could be located at a reasonably early stage, they could be eliminated at relatively little expense, thus preventing further spread from these points, at least. Accordingly the country within approximately thirty-five miles of Washington, D. C., was chosen in the fall of 1908 as preliminary territory in which to test this method of control. This section has been gone over fairly thoroughly once a year. As will be shown by Figure 1, fourteen points of infection were located and the infected trees destroyed. Most of this work was done by the senior writer. The largest infection was a group of nursery trees that had been imported from New Jersey; the smallest, a simple lesion on a small branch of a large forest tree. In one case eleven forest trees in a group were infected, the original infection having been on two trees dating apparently from as early as 1907. Up to the present time (June, 1911) the disease has not reappeared at any point where eliminated, and the country within a radius of approximately thirty-five miles from Washington is apparently free from the bark disease, although new infections must be looked for as long as the disease remains elsewhere unchecked. It is therefore believed that this method of attack will prove equally practicable in other localities, and if carried out on a large scale, will result ultimately in the control of the bark disease."

Stewart, of the Geneva, N. Y., Station, and the writer, through the kindness of Metcalf, had the opportunity of examining, in January, 1912, part of the region where this work was carried on. Stewart (70) in his paper at Harrisburg said: "I hold

writer also believes that the apparent results would not justify the application of the method on a wholesale scale in other regions, for the following reasons: (1) Apparently neither the chestnut tree nor the blight disease was very common in the region under experimentation; hence the greater difficulty of the disease starting there, and also the greater ease with which it could be controlled. (2) Although those in control evidently made a careful survey of the region for the blight, they overlooked infected trees. In a region with the chestnut tree and the disease more abundant, it would be impossible to locate all the diseased trees. (3) Where infected trees were cut down, the disease appeared on the bark of the stumps in some cases. To destroy the bark on the infected stumps as well is too great a task to be successfully accomplished without great expense. (4) No check areas, apparently, were reserved with which to compare the results of the treatment.

Yet, based on this experiment apparently, local advocates of such measures succeeded in having the State of Pennsylvania establish a chestnut blight commission to fight the disease in that state along these lines. To aid in the further study of the disease in all its aspects and in the control work, a grant of $275,000 was made by their Legislature. Shortly afterward, the United States Government also appropriated $80,000 for further work by Metcalf's department. With the aid of the government, and with more or less state aid, several of the states south of Pennsylvania have taken up this work, chiefly along the lines advocated by Metcalf and Collins, though apparently so far most of this work has been in the nature of preliminary surveys for locating the disease.

In order to have a clearer idea of what has been accomplished in a practical way in Pennsylvania by this commission, we recently wrote Carleton, who is now general manager, the following letter: "I understand from newspaper reports that the chestnut blight commission of Pennsylvania has found that spraying with Bordeaux mixture is effective in controlling the disease. I wish to ask for a statement from you concerning this report. Also, I should like very much to know what has been the outcome of your quarantine and cutting out work as carried

like to know if the blight on the whole, without regard to treatment in checking it, has spread as seriously in Pennsylvania during the past year as it did in 1911. So far as Connecticut is concerned, there seems to be a decided improvement, if we can judge by the reports that we have received."

In answer to this letter, under date of March 1, 1913, Carleton wrote as follows: "I have your letter of February 28th, and in reply will say first, that the reports in the papers about the spraying with Bordeaux mixture in connection with chestnut blight were, as usual, much exaggerated, and in some respects quite erroneous. The use of Bordeaux mixture is, at most, only a preventive, though the papers reported it to be a cure. Of course, as you know, nothing will cure the disease after it is in the tree. The Bordeaux was used on the estate of Pierre DuPont near Kennett Square. In connection with tree surgery methods, and by spraying about every two weeks during the summer, these two methods taken together appear to have controlled the blight. It is believed that the Bordeaux mixture was of great use in preventing the germination of spores on healthy trees, and on healthy portions of trees that were being treated. I believe the spraying with Bordeaux is of sufficient importance in chestnut orchards to recommend its practice in all cases of chestnut blight. It might be used, also, on unusually valuable lawn trees, but of course, it would be impracticable in forest tracts, chiefly on account of the cost, and for other reasons.

"As to the spread of the blight in Pennsylvania, I regret to say that over a large portion of the state it has apparently spread more rapidly than the year before, so that the conditions appear, therefore, to be different from those in Connecticut, according to your statement. Because of the condition last stated, of the serious increase of the disease in this state, and particularly in those portions west of the Susquehanna, where we are endeavoring to check its progress, you can see that our work has been unusually difficult. Answering your question, however, as to our success in actually checking the blight, so far as we can get evidence one way or the other at all in the short time that I have been in the state, I believe we have accomplished a great deal in that line. We can only actually know next summer when we re-scout the areas over which cutting

have been re-inspected, the evidence is that our work has been very good. There was some return of the disease, of course, as was to be expected, but a rather small percentage."

Experiments in Connecticut. In Connecticut there has been no appropriation of money by the state to investigate the chestnut blight, and none has been asked for. Such work as has been done has been carried on by the botanical and forestry departments of this Station with funds at hand, and in connection with their other duties. There has been no attempt to enforce state control of the disease, or to eliminate it by the cutting out and quarantine method. There has been no demand for such treatment on the part of those interested. Preliminary surveys have shown that the disease now exists in all the towns, and in some of them to such an extent that any attempt to gain control of the fungus by the cutting out method, even if successful, could only be made at a cost disproportionate to the good that would be accomplished. Add to this the constant watch that would have to be maintained against re-infection, the opposition that would be aroused among some property owners by the enforced cutting, and we have sufficient reason for not attempting such a program in this state. Then, too, none of the surrounding states, Rhode Island, Massachusetts, or New York, is attempting such control.

In order, however, to gain some idea of the value of the cutting out method, two experiments, in coöperation with the forestry department, have been conducted in this state. The first was at the Whittemore estate in Middlebury, and was largely preliminary in nature, being carried out by Mr. Shepardson, manager of the estate, at our suggestion, but not immediately under our control. The disease was rather bad in certain of the woods on this large estate, and in a special effort to protect those nearest the residence, the removal of all infected trees was started in 1910. These woods have now been gone over four different years, each time removing all trees of whatever size showing cankers. Apparently this removal has had little effect in decreasing the disease in these particular woods. A count was not made of the number removed each year, except that Mr. Shepardson states that more were removed in the winter of 1912 than in all previous years. In these

which contained trees over one foot in diameter, 845 trees over one foot in diameter were marked for removal in the winter of 1912-13, besides numerous trees and sprouts of less diameter. This same winter, in all the woods on the estate, there were 2,200 trees over one foot in diameter that were marked for removal. In this experiment it was not attempted to remove the bark from the stumps. In certain badly diseased spots where the stumps were examined, it was found that perhaps 30 per cent. of them showed some signs of the fruiting stage of the fungus the following summer.

The second experiment was started in the fall of 1911, at the Portland state forest. Here certain designated wood lots, eight in number, were gone over, and all trees and sprouts showing cankers were noted and marked for removal. These were removed during the following winter, and the wood and bark disposed of. A partial reëxamination was made the next spring, to determine how effectively the work was done. In spite of the fact that the preliminary examination had been carefully made by two well-trained scientific men, and the ground had again been gone over by a practical man who removed the marked trees and any others he saw to be infected, it was found that some of the diseased trees had been overlooked. Six other lots in these woods were also examined, and the blighted trees counted, but not removed, these serving as a check to determine the benefit of removal in the other lots.

All of these lots were reëxamined in the fall of 1912, and the trees removed that winter, as before, from those lots reserved for removal. It is expected to keep up this experiment for several years, if warranted by the results or the prevalence of the blight. As yet it is too early to determine the effect of the removal of the trees on the spread of the blight by comparison with the check lots. So far as the second year's results go, however, there were proportionately just as many newly blighted trees found in lots where all had been removed the year before as in the lots where all diseased trees had been left.

RECOMMENDATIONS FOR CONNECTICUT.

We are not advocating concerted action throughout the state

where probable results might seem to warrant it, such as isolated woods recently and slightly infected, and of sufficient value to warrant the expense. Where a wood lot as a whole is merchantable, and the disease is present, we advocate that, if market conditions are favorable, it be cut and disposed of in the ordinary way. Where the trees are not as a whole of marketable size, and the disease is present, we advocate the removal of the dead and badly diseased trees and their disposal as lumber, poles, ties or cordwood, as their size will permit.

We have no uniform recommendations for treatment of sprout growth too small for market purposes, but as a usual thing no treatment is recommended. Where trees have been cut, and numerous sprouts are developing, it is perhaps advisable at the end of the second or third year to go over these and cut off all the diseased and weak ones, leaving only four to six vigorous ones, to renew the stand if possible.

We are trying to prevent a glut of the market by discouraging wholesale cutting of the forests, especially where there is little need of it. As yet there has been no general glut and drop of prices except on cordwood in certain towns, and 7 x 9 ties, for which the demand on the part of the railroad has evidently fallen off. On the whole, however, there has been considerable more timber cut than usual.

There are no small factories for the utilization of waste products such as tannin, etc., and the establishment of such here is not likely or advisable. In the recent investigations of the wood-using industries of Connecticut, by Pierson of the United States Department of Agriculture, published as Bulletin 174 of this Station, it is stated that the chestnut is used by nineteen different industries in wood manufacture, of which 50 per cent. of the supply used is for musical instruments. Of all the chestnut timber used, however, only 35 per cent. was Connecticut-grown.

Whether the consumption of the home-grown product can be profitably increased is a question we cannot answer here, but is worthy of the attention of the timber growers and buyers. The largest use made of the chestnut trees is for building timber, telephone poles, railroad ties, and cordwood. The latter, besides its extensive family use, is consumed in brick kilns, brass foundries and charcoal pits. Its consumption by brass factories.

LITERATURE.

Although chestnut blight is a comparatively new disease, the literature on the subject has already become rather extended, because of the popular interest aroused. We do not aim to include all of the popular articles, but do include all articles, so far as we know, that relate to any special study of the disease. These are arranged alphabetically according to their authors, and for convenience in the preceding discussion have been referred to by the appended numbers.

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GENERAL SUMMARY.

(1) Chestnut blight was first noticed in this country by Merkel, of the New York Zoological Park in 1904, and in 1906 was attributed by Murrill, of the New York Botanical Garden, to a fungus which he described as new to science, and called Diaporthe parasitica.

(2) The chestnut blight fungus has now been found in twelve states, from New Hampshire and Vermont on the north to Virginia and West Virginia on the south, and the damage that it has caused has been variously estimated from twenty-five to one hundred million dollars.

(3) The fungus consists of a conidial, or Cytospora stage, and a mature, or asco-stage, produced one after the other in the orange- to chestnut-colored fruiting bodies, which break out of the bark as small, more or less clustered pustules. The fungus has also rarely been found on oaks, where as yet it causes no particular damage. In artificial cultures only the conidial stage occurs, whose spores exude in viscid drops, or rarely in tendrils as in nature. Artificial inoculation of chestnut sprouts or seedlings produces the characteristic cankers in the bark, and these can be produced somewhat in oak sprouts.

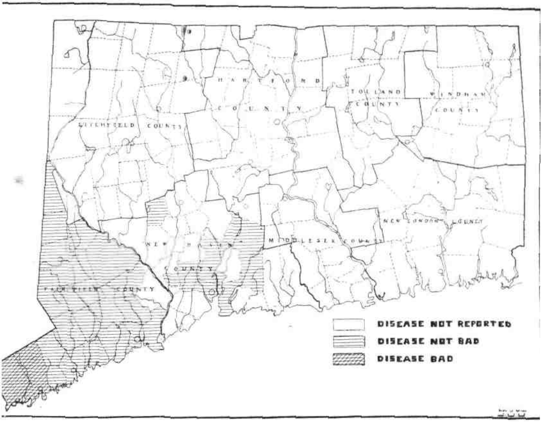
than Diaporthe. It has two saprophytic or semi-parasitic relatives in this country, known as Endothia *radicalis* and Endothia gyrosa. The latter also occurs on chestnut, and the chestnut blight, being very similar morphologically, has been referred to it by the writer as a parasitic variety called Endothia gyrosa var. parasitica. Others have considered the two as entirely distinct species, and still others as forms so closely related as to be identical morphologically.

(5) While no record, either here or abroad, has been found of any previous outbreak of the blight fungus, there have been reported at different times in the past century unknown chestnut troubles in the southeastern United States that possibly may have been due to it.

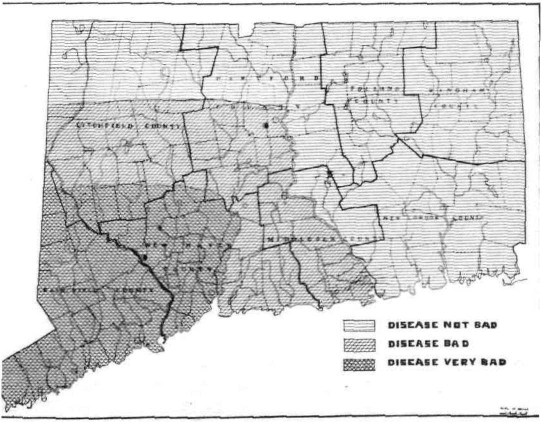
(6) The blight fungus has been considered by Metcalf as an importation from Japan, and by Shear as introduced from Europe, while the writer maintains that it is a native fungus, which, because of peculiar conditions detrimental to the host, has assumed unusual virulence and widespread prominence.

(7) These conditions unfavorable to the host were in part the unusually severe winter of 1903-04, which injured trees in general in the northeastern United States, and after which the blight suddenly made its appearance, and in part the subsequent unfavorable seasons for trees, especially the last four or five years, when summer droughts were unusually severe.

(8) If the writer's conclusions are correct, then it is useless to try to make a widespread fight against the fungus, since it will, under conditions favorable to the host, return in time to its former inconspicuous parasitism. If they are incorrect, it is still a question whether or not the cutting out and quarantine method is effective and can be carried on so economically and extensively as to be of practical value.

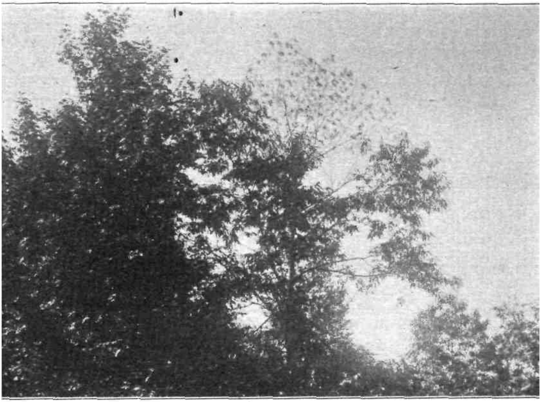


a. Known Distribution of Chestnut Blight in 1908.



b. Known Distribution of Chestnut Blight in 1912.

DISTRIBUTION OF CHESTNUT BLIGHT IN CONNECTICUT, p. 371.



a. Tree with single branch killed, p. 365.

b. Trees killed by Chestnut Blight.

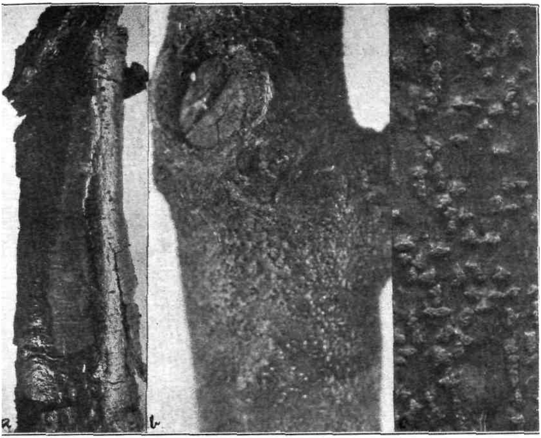
CHESTNUT TREES INJURED BY BLIGHT.

a–b. Cankers on smooth (a) and rough (b) barked trees, p. 364.

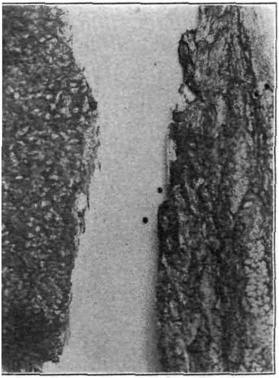
c. Winter-injured tree, p. 392.

d. Injury showing on pole, p. 365.

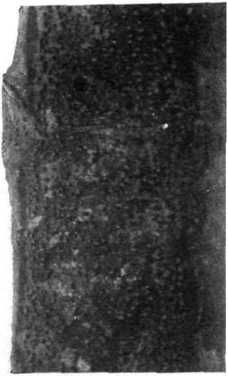
CHESTNUT BLIGHT INJURY, ETC.



a–b. Blight started through insect injury (a), and pruned branch (b);
c. Mature fruiting pustules on smooth bark, p. 366.

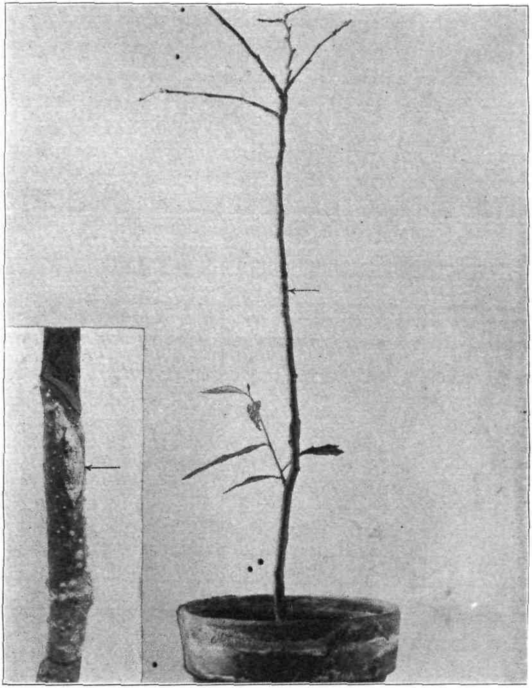


d. Blight on rough bark.

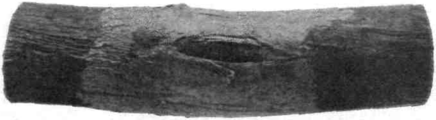


e. Fruiting pustules of *E. radicalis*, p. 41

FRUITING PUSTULES OF BLIGHT AND ENDOTHIA RADICALIS



a. Tree killed above inoculation point ; canker shown by the enlarged stem, p. 4

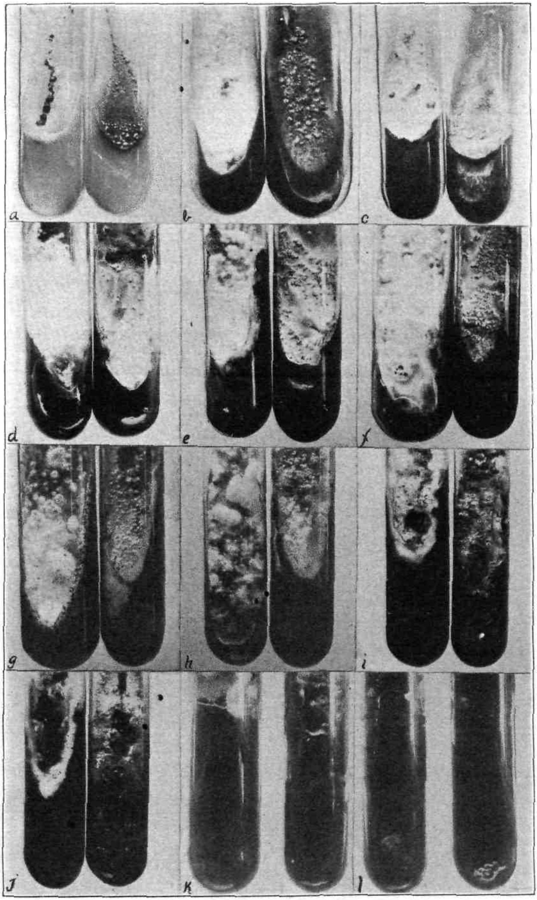


b. Sprout with dead bark around inoculation point, p. 366.

ARTIFICIAL INOCULATIONS OF BLIGHT.

7596. *E. radicalis*. 7590, 7584. *E. gyrosa*. 7582, 7581. *E. gyrosa* var. *para*

PETRIE DISH CULTURES OF THREE AMERICAN ENDOTHIAS.



-l. *E. gyrosa* first in each case, on following per cents.: a, 0; b, .2; c, .4; d, .8
e, 1.2; f, 1.6; g, 2.4; h, 3.2; i, 4.; j, 4.8; k, 6.; l, 10.

TANNIC ACID CULTURES OF ENDOTHIA GYROSA AND VAR. PARASITICA, p. 430

a, d, g. *E. radicalis*. b, e, h, j. *E. gyrosa*. c, f, i, k. *E. gyrosa* var. *parasiti*
367. a–c. ascospores; d–f. spores in ascus; g–i. conidial spores; j–k. isola
ithecia, k. showing mycelium from germinating ascospores within.

SPORE STAGES OF THREE AMERICAN ENDOTHIAS.

PART VI.

REPORT OF THE STATE FORESTER

WALTER O. FILLEY.

INTRODUCTION.

The Forester of the Connecticut Agricultural Experiment Station is *ex-officio* State Forester and State Forest Fire Warden. The work of the Department of Forestry may accordingly be classed under three heads.

The Station Forester works along the following lines:

1. Investigation of forest conditions, and the problems involved in the profitable management of Connecticut woodlands. This is carried out on both State and private lands.

2. Experimental work in forest planting and management. As such experiments must be carried on for a term of years to secure results of value, most of this work is on land belonging to the Station or to the State, although occasionally experiments are undertaken in coöperation with private land owners.

3. Dissemination of information regarding forestry. In accordance with the established policy of the Experiment Station, the Forestry Department aims to help woodland owners and the public in general to obtain a knowledge of forestry principles and methods. To accomplish this object, practical assistance is given to all applicants so far as possible, either by correspondence, or preferably by means of examination of land and recommendation as to treatment; news articles are prepared for the press, and publications are issued from time to time giving the results of investigations and experiments with the practical application of the lessons learned; public addresses and illustrated lectures are given before farmers' institutes, granges, and other organizations which may be interested.

The State Forester has charge of the State Forests already established, and is authorized to establish others as funds may be made available for the purpose. It is his duty to protect and to develop these State Forests by planting, and by improvement cuttings, the receipts from such cuttings being used for further improvement work.

The State Forest Fire Warden is the head of a fire warden service which includes a town fire warden in each town, and such district or deputy wardens as conditions in each town may render necessary. The forest fires extinguished by local wardens are reported by them to the State Warden accompanied by bills for services rendered or expenses incurred. Such bills, after examination as to legality, are recorded and referred back to the towns for payment on approval by the selectmen. From a study of the fire reports, facts are determined as to the causes of fires, and the best methods of preventing and extinguishing them. As the State Forest Fire Warden is responsible for the efficiency of the service and enforcement of the laws regarding forest fires, it is incumbent on him to issue such instructions and supplies as will bring about the desired results. Press bulletins and other material of an educational nature are also issued from time to time.

These various branches of the regular work of the Department are taken up in detail on the following pages, the order of their discussion being reversed for convenience in arrangement. During 1912, the forester was involved in a special line of work which is not fully covered in this report. He was *ex-officio* a member of a Special Commission on the Taxation of Woodland, authorized by the General Assembly of 1911. As secretary of this Commission he found it necessary to give considerable time to the gathering of material and preparation of a report. This report is to be presented to the General Assembly of 1913 and will form the basis for legislation on the subject of forest taxation. Copies may be obtained from the State Forester or the State Tax Commissioner.

The proposed legislation will provide a just system of taxation for all forest land in the State, but will be optional in its application. Opportunity will be offered for the classification of forest land as such, a fair valuation of the land for purposes of

taxation to be established and maintained without change for a definite period of years. An annual tax on this valuation of the land alone will be provided for in addition to a yield tax on the timber when cut. Such a law will be an encouragement to investors in forest lands, for it will make it possible to determine definitely the amount of taxes chargeable against such an investment in future years. This will remove one of the factors which has interfered with the progress of forestry work in this State, since uncertainty regarding taxation is a heavy handicap to a long time investment.

The first Station Forester, appointed April 1, 1901, was Walter Mulford, F.E., Cornell. He was appointed State Forester, July 1, 1901. On July 1, 1904, he was succeeded by Austin F. Hawes, M.F., Yale. By act of the General Assembly he also became State Forest Fire Warden in July 1905. He resigned April 1, 1909, and Samuel N. Spring, M.F., Yale, was appointed State Forester on October 1, 1909. Having served for two years as Assistant in Forestry, the writer was appointed Assistant State Forester, October 1, 1911, in accordance with an act of the General Assembly providing for such an office. Mr. Spring resigned October 1, 1912, and the writer was appointed his successor. Mr. A. E. Moss, M.F., Yale, was appointed as Assistant in Forestry from that date.

This report for 1912 is intended to sum up the work of the Forestry Department in all lines since its establishment. The policy of the present Forester will be in accordance with that of his predecessors, but he will have the advantage of building on the foundations they have laid and should therefore be able to show a distinct advance in the forestry work of the State during the next few years.

FOREST FIRES.

The report of the Forester for 1910 was largely devoted to this subject, and discussed fully the results of the Fire Warden work for the years 1905-1910. Especial attention was given to the figures for 1910, because the conditions in that year were such that a large number of fires (834) occurred, and it seemed probable that this would prove to be a maximum record which would not be equalled in succeeding years.

TABLE I.—NUMBER OF FOREST FIRES BY MONTHS.

Year.	Total Number.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1910.......	834	0	0	285	305	45	2	9	0	6	141	41	0
1911.......	978	5	0	66	425	390	13	20	25	1	10	21	2
1912.......	526	1	3	27	109	90	34	53	5	3	142	38	21

By reference to Table I, it will be seen that this expectation was unfulfilled. The conditions in 1911 were worse than in 1910, especially during the months of April and May, when 815 fires occurred. Although the warden service was more efficient and more vigilant than ever before, a total of 978 fires was reported with damage, cost, etc. as given in Table II.

TABLE II.—SUMMARY OF FOREST FIRES, 1911.

County.	Total number.	Causes. Unknown.	Railroad.	Careless.	Burning Brush.	Incendiary.	Fireworks.	Lightning.	Acres burned.	Estimated damage to standing timber.	Estimated damage to forest products and buildings.	Cost of fighting.	1
'airfield.....	147	69	38	18	20	2	..	..	5,376	$11,585.50	$ 637.00	$1,684.35	$2
Iartford	207	90	69	25	19	4	..	..	13,550	67,982.00	13,420.00	3,784.54	3
.itchfield.....	162	49	69	18	22	4	..	..	14,604	41,302.00	3,444.50	2,616.29	1
Iiddlesex ...	69	24	29	6	9	1	..	..	6,128	26,389.00	1,449.00	714.63	
Iew Haven..	143	69	40	18	16	..	..	..	7,073	30,008.00	2,492.00	1,693.04	
iew London.	73	52	6	8	6	1	..	..	8,074	20,660.00	1,105.00	1,079.76	
'olland......	78	27	26	14	11	..	..	..	4,697	25,613.50	16,427.00	1,605.50	
Vindham.....	99	36	42	10	5	5	..	1	5,496	30,475.00	2,610.50	1,803.39	
Totals	978	416	319	117	108	17	..	1	64,998	$254,015.00	$41,585.00	$14,981.50	$7

Conditions in 1912 were very much better, particularly during the spring, when most fires occur in a normal season. Rains during the previous fall and abundant snows during the winter had matted down the leaves, and the rainfall during the first five months was more than six inches in excess of the normal. Consequently very few fires occurred and few of those reported caused large damage. After June first, conditions changed greatly and but one half inch of rain fell during the month. The precipitation was considerably below normal in each succeed-

fires were frequent and exceedingly difficult to put out owing to the dryness of the soil. Many fires burned underground for a week or more, covering only a few acres in each case, but requiring constant watching to prevent their getting beyond control.

Table III gives the complete record for 1912. In comparison with previous years it shows a less number of fires (526) than 1910 and 1911, and less area burned over than in those two years, as well as in 1908, when the number of fires reported was but

TABLE III.—SUMMARY OF FOREST FIRES, 1912.

County.	Total Number.	Causes.							Acres burned.	Estimated damage to standing *timber.*	Estimated damage to forest products and *buildings.*	Cost of fighting.	C... pr... ti...
		Unknown.	Railroad.	Careless.	Burning brush.	Incendiary.	Fireworks.	Lightning.					
airfield	44	17	20	5	1	1	...	...	832	$ 1,786.00	$ 107.00	$ 143.28	$20.
artford....	129	44	44	26	9	2	1	3	5,088	21,572.00	5,377.24	2,011.20	15
itchfield ..	87	28	35	13	7	...	3	1	2,344	6,286.00	396.00	1,142.88	18
Iiddlesex..	41	18	14	7	2	...	...	...	1,924	6,617.00	50.00	261.20	9
ew Haven.	82	39	10	22	2	5	3	1	868	2,878.00	681.00	653.38	7
ew London	35	13	3	18	1	...	...	...	1,878	7,565.00	51.00	468.91	3
olland.....	43	12	16	13	2	...	...	...	738	2,494.00	4,377.50	486.99	2
'indham ...	65	22	31	7	2	3	...	...	1,943	6,834.00	145.00	499.80	2
Totals ..	526	193	173	111	26	11	7	5	15,615	$56,032.00	$11,184.74	$5,667.64	$79

little over one-half as large. (See Table IV.) The cost of fighting also shows a considerable decrease over the two previous years both in gross and per fire. This cost would have been much smaller had it not been for a few summer fires which burned for several days. Although weather conditions must be given much credit for the good record of 1912, the activity and efficiency of the wardens should not be underestimated. Their vigilance prevented many small fires from becoming serious. On the whole, there is plenty of evidence that the fire warden service is more active and efficient each year, and it is evident that with a few exceptions, the towns of the State are realizing the necessity for extinguishing fires promptly.

Prompt action by wardens means smaller damage as well as less expense to the towns and State. Wardens, however, cannot be expected to neglect their other business to watch for fires,

no matter how public-spirited they may be.* It is therefore very desirable that assistance in locating fires be rendered the wardens in every way possible. For this purpose, the U. S. Post Office Department has instructed rural mail carriers to report to the nearest warden as soon as possible, any fires they may see in covering their routes. This should prove of great assistance in Connecticut, as most of the forested area is covered by carriers once each day.

TABLE IV.—SUMMARY OF FOREST FIRES, 1905–1912.

Year.	Number of wardens.	*Number of towns not reporting.	Number of fires reported.	Area burned. (Acres.)	Average area per fire. (Acres.)	Cost of fighting.	Average cost per fire.
1905	44	126	...	†8,000	....	....	.....
1906	119	94	125	4,036	32.3	....	.....
1907	140	76	109	4,387	40.2	$1,286.46	$11.80
1908	152	64	283	18,430	65.1	3,646.66	12.88
1909	157	18	339	14,779	43.6	2,755.46	8.13
1910	160	19	834	47,443	56.9	10,024.76	12.02
1911	163	9	978	64,998	66.5	14,981.50	15.32
1912	168	28	526	15,615	29.7	5,667.64	10.77

* Includes nine principal cities whose limits are coterminous with those of the town.

† Estimated at the end of the year.

It also seems desirable to establish lookout stations on a few high points in the State from which observers may watch for smoke of forest fires during the danger seasons. If the stations are equipped with telephones, the observers will be able to locate fires definitely and inform the nearest wardens at once. Two stations were maintained experimentally during 1912 with valuable results, even though the favorable season made their value less apparent than it would have been the previous year. If possible, other stations will be established during 1913, the State coöperating with towns and land owners when practicable.

Under the so-called Weeks Law, which provided for National Forests in the White Mountain and Appalachian regions, the Federal Congress authorized the U. S. Forest Service to coöperate with the various states in protecting from fire the forested watersheds of navigable streams. Federal funds were thus made available for use in paying for the services of observers at look-

out stations in northern Connecticut. This arrangement will be continued in 1913.

Past years have shown that a large proportion of the fires in this State are due to sparks from railroad engines. During the spring of 1912, when fires were few on account of plentiful rains, forty-one per cent. of the fires reported by wardens were attributed to this cause. In 1911, when fires from all causes were more frequent, only thirty-five per cent. were reported as railroad fires. Believing the value of patrols should be demonstrated with a view to securing future coöperation with the railroad companies in such work, ten patrols were maintained during the danger season along stretches of track where fires are of common occurrence. These patrols were paid by the Federal government under the coöperative arrangements mentioned above. They reported extinguishing 270 small fires during the year. These were in addition to the number reported by wardens (172), and many of them would probably have become serious had they not received such prompt attention. With the figures thus obtained as a basis, plans for patrol work will be submitted to the railroad companies, with the expectation that they will do such work where needed in 1913.

Chapter 114, Public Acts of 1911 provided that all bills for extinguishing fires due to railroad causes should be paid by the company responsible. Under this law, bills amounting to over $600 were paid during 1912. Had the law been in effect in the spring of 1911, the fire bills to railroad companies would have undoubtedly shown a larger total, and the cost of fire fighting to the towns and State would have been correspondingly reduced. If the money spent in this way and in settling damage claims were used in patrol work and other preventive measures, the resources of the community would suffer less damage from fire.

In the future more attention must be given to measures of prevention calculated to eliminate, so far as possible, the more easily determined causes of forest fires. The railroad fire problem is the most obvious, and its solution should be easy provided the railroad companies will coöperate with the State. Other causes must be eliminated largely by educational measures which will arouse the general public to a sense of its responsibility regarding forest fires. Enforcement of the laws providing penalties

for carelessness with fire will help greatly by furnishing a few object lessons. Much can also be done in the public schools and through the press to emphasize the need for care in handling matches, cigars, etc. when in the woods. To emphasize the need of such work, the following analysis is given of 137 fires reported during 1912 as due to carelessness on the part of individuals:

Auto party	1	Matches	5
Burning brush	26	Smokers	25
Children	6	Strollers	2
Fishermen	4	Not given	21
Hunters	47		

It is evident that most of these fires were due to carelessness in handling matches, throwing down cigar butts, etc., or leaving fires unextinguished. It also seems reasonable to believe that very few of the people responsible for such fires would have intentionally set them, since their presence in the woodland would indicate that they enjoyed the natural conditions found there. Hence the belief that the public can be educated to the need for greater care to preserve such conditions from destruction by fire.

State Forests.

With the appointment of a State Forester in 1901, Connecticut adopted the policy of acquiring land for State Forests. The value of land which might be purchased was limited by law to four dollars per acre, and no specific appropriation was made for the purpose until 1909. From the biennial appropriations of $2,000 each which were provided to cover the expenses of the State Forester, including travelling, taxes, protection, planting and other expenses incident to the administration of the State Forests, a total of 1,512 acres of land was purchased previous to 1909 at an average price of $2.10 per acre. This increasing area caused greater expense of administration with consequent reduction in amount available for purchase. Increasing difficulty was also met with in securing desirable lands at prices within the specified limit of four dollars per acre.

The General Assembly of 1909, therefore, made an appropriation of $5,000, to be available until expended, for the purchase of land suitable for State Forests, and in 1911 the maximum

purchase price of such land was increased to eight dollars per acre. This limit gives a better opportunity to secure desirable tracts of land which would otherwise be unavailable on account of price. In most cases the cheaper lands are located so far from the railroad that it is not only difficult to market the timber products but they are not sufficiently accessible to visitors to render them of the greatest value as State Forests.

The purpose of such forests in this State is two-fold. First, they should be demonstration areas where the application of forestry principles to local conditions may be shown to woodland owners and experiments in afforestation and management may be carried on for a long period. Second, they should be reserves for the growth of large timber, since the State is much better able than private owners to carry such long term investments. Thus they may be considered a source of future profit to the State, as well as a source of future supply of large timber for local uses.

Since conditions vary considerably in different parts of the State, it is desirable that the demonstration areas be located in different regions so as to include these various conditions. The location of a State Forest in each county would assure this result. It has therefore seemed best to acquire contiguous areas which could be thrown together and managed as one large tract in each county, rather than a number of widely separated small tracts which could not be combined to advantage. Two thousand acres of woodland can be more economically managed than five hundred or one thousand acres. So far, however, it has not been practicable to acquire a tract of two thousand acres in one piece, although this has been the aim of each State Forester.

The Portland State Forest, in the towns of Portland and Chatham, now contains approximately 1,100 acres of land, bought at an average price of $1.90 per acre. Most of this land had timber growth of some sort, and much of this was of sufficient size to permit improvement cuttings or thinnings. The products of such thinnings were disposed of to the best advantage as railroad ties, posts, or cordwood. On account of the distance from market, no profit has been made on the cordwood from thinnings and the best returns have been obtained by selling it to local charcoal burners. Approximately 125 acres have thus

been thinned, the wood removed paying in part for the work done and the remaining stand being left in better condition.

During the past two years damage from the chestnut bark disease has become more apparent in the State Forest, and experiments have been started to determine the practicability of checking the progress of the disease on a definite area by removing all infected trees. No definite results have as yet been obtained, except that it is evidently impossible to locate all the diseased trees without going over the ground more than once. This subject will be more fully discussed in the report of the Botanist (Part V).

Some portions of this Forest had been so severely culled before purchase by the State that very little growth of value remained. One such area of about 15 acres was cleared and planted with pine in the spring of 1912. Another tract with a good growth of chestnut sprouts large enough for small poles, was damaged by fire in 1908. Following the fire most of the trees became infected with blight to such an extent that the timber was sold to a lumberman. The best of it has already been removed, and after the cordwood is cleaned off the area will probably be planted to pine. Adjoining areas of cutover land will be added to the Forest whenever they can be advantageously purchased, and will be planted with coniferous trees in most cases.

A total area of about 30 acres has already been planted with white pine, red pine and Norway spruce, and other land will doubtless be so planted each year. Only the more valuable and more rapid growing stands of hardwoods will be maintained as such, the poorer quality and slower growing stands being transformed into a more profitable coniferous type as rapidly as possible. These will permit of more intensive management, since the more valuable prospective yield will warrant a larger expenditure in protection and management.

To carry out this work systematically, a working plan for a short term of years is desirable. Most of the necessary data was gathered during 1912 and the publication of such a plan as a Station Bulletin is anticipated during the coming year. It will include a type and stock map of the Portland State Forest showing the present stand with recommendations as to future

The Union State Forest is a tract of 288 acres in the town of Union purchased in 1905. Much of it was open farm land of rather poor quality, and was purchased at an average price of a little over $3 per acre. As there was practically no timber of value on the area, no improvement cuttings have been made but considerable planting has been done on the open land. In all, about 55 acres were planted with white pine, and two small areas of about 2½ acres each were planted with Scotch pine and European larch respectively. In the spring of 1912, failures in all the plantations were filled with two-year Scotch pine seedlings, making an irregular mixture of white pine and Scotch pine throughout most of the planted area. Scotch pine was used for this purpose because its more vigorous growth would give it a chance to overtake the already established white pine. As this tract is situated in a pine region, it is particularly desirable that a good stand of pine be established. Considerable work has been necessary in checking the white pine weevil during the past two seasons. The mixture of Scotch pine with the white pine should tend to reduce the damage from this cause, as the weevil does not thrive in the former species.

The Simsbury State Forest consists of 130 acres of brush and cut-over land which had been considerably damaged by fire before purchase by the State in 1908. As the tract is crossed by a railroad, a good opportunity was presented to practice protection from fire, and with the exception of one fire in 1910, this has been successful. Twenty acres have been planted with Scotch pine, twenty-two acres with white pine and three acres or more with red pine, European larch and Japanese red pine. It is intended to extend these plantations from year to year until the entire tract is growing pine instead of the present growth of poor quality hardwoods. The soil is rather light and sandy throughout most of the area, and should be well suited for the growth of pine. Fire lines have been cleared along the railroad track and across the tract so as to make protection from fire practicable. This forest is accessibly located and as a demonstration area has decided advantages, but it is not large enough to be economically managed, and it is hoped that more land may be acquired before many years.

THE STATION FORESTER.

It has already been stated that the work of the Station Forester follows three lines; investigation, experiment and dissemination of information. These lines are closely associated and often overlap. In many cases, an investigation involves experiments, and experiments may require preliminary investigation. The publication of results, in either case, is an educational measure intended to increase the knowledge of forestry methods and an interest in their practical application, as a means of obtaining improved forest conditions and increased forest values.

The improvement of the present forest so as to secure its maximum yield, and the increase of the forest resources of the State by more intensive use of land suitable only for forest growth, are two distinct problems, although they have much in common. In the greater part of the State, the present forest consists of second growth hardwoods with a large percentage of chestnut, either in pure stands or mixed with other species. These chestnut stands have been considered a source of profit to their owners in the past, and because of their ability to renew themselves by sprouts and to grow rapidly on good sites, have been cut clean at intervals of from twenty to forty years. For several generations the market for railroad ties, telephone poles and other products for which chestnut is adapted, has been very good, and no other hardwood tree has been such a source of revenue to the Connecticut farmer. Because of its greater sprouting ability and more rapid growth it seems probable that chestnut has increased in quantity in the State during the past fifty years as compared with other hardwood species which formerly grew in mixture with it.

Other factors have been at work during recent years, however, which bid fair to rob the chestnut of its supremacy as a favorite timber tree. The cutting of successive generations of sprouts with practically no regeneration by seed has inevitably resulted in a less vigorous and shorter-lived stand. In many cases, failure of some stumps to sprout, or the destruction of some sprouts by drought, winter-killing or fire has produced a more open stand, or given a chance for light-seeded weed trees like poplar or birch to become a part of the stand. Thus many

stands of chestnut have gradually deteriorated until to-day they are not producing half a cord per acre of valuable wood per year.

Fire has had a great deal to do with this deterioration, for chestnut is thin-barked and not fire-resistant like most oaks. It is therefore more easily damaged, and even surface fires will sometimes completely destroy stands of chestnut sprouts big enough for posts. Older and heavier barked trees are often so seriously damaged that large patches of bark are killed and loosen up for several feet above the base of the tree in time. A second fire finds easy access to the wood itself, and even though no second fire occurs, the loosened bark gives a chance for insects and fungi to enter the wood, so that decay at the base of the tree is almost sure to follow fire. The roots are often injured also and a decrease in vitality follows, so that when the tree is cut, it not only proves to be unsound, but is lacking in sprouting ability. Occasionally fire scars heal over so that they are not apparent on the outside, but this is less apt to happen with chestnut than with oak, and even a scar which has completely healed is a detriment to the quality of the log in which it occurs.

Improvement of the present forest to secure its maximum yield involves protection from further damage by fire. This is so evidently essential that its need will not be further emphasized here. Something besides protection from fire is necessary, however, if the maximum yield is to be secured from any stand of forest trees. Improvement thinnings should be made from time to time to remove, 1st, weakened and suppressed trees which can never produce first-class material and will probably succumb to competition anyway; 2d, trees of inferior species which if left will not only interfere with the growth of better individuals but tend to increase the quantity of inferior material in the stand; 3d, crooked or damaged trees which, while preventing the best development of other trees, will never be worth much themselves. Such thinnings not only prevent much waste of material, but if properly made with due regard to maintenance of the crown cover, hasten the maximum development of the most valuable trees in the stand.

Thinnings are as essential to the production of a timber crop as thinning and weeding are to the production of a crop of beets or onions. Theoretically, thinnings should be made in a wood

lot just as soon as the trees begin to crowd each other, but in practice it is customary to wait until the products of a thinning will approximately pay its cost. Later thinnings yielding larger material may show a profit, but an increased final yield would warrant such cultural operations in most cases, even though at some expense.

Cuttings are sometimes necessary for the express purpose of removing trees injured by fire, wind, drought, insects or fungi in order that the damaged material may be utilized, aud in the case of insects and fungi, that further damage may be prevented if possible. Such damage cuttings are usually only of local importance, and confined to a small area, but occasionally the ravages of an insect pest or a fungous trouble may affect a considerable territory, and destroy a large part of its forests.

Just at present chestnut in this region is suffering from a fungous trouble (the so-called chestnut bark disease or blight) which has already killed a large proportion of the chestnut trees in south-western Connecticut and is known to exist all over the State (see Botanist's Report). As the fungus is a parasite which cannot be very successfully treated with a fungicide, and as it spreads by means of spores probably carried by the wind and insects, the only way of checking it seems to be by the complete destruction of the diseased trees, which may be sources of infection. The expense of this operation would render it impractical in stands not yet of merchantable size where diseased trees are abundant. The removal of isolated infected trees would probably tend to check the spread of the disease, but since it is impossible to detect the presence of the disease when the infection first takes place, it is difficult to eliminate the trouble even by such radical methods.

If the spread of the disease has been assisted by a weakened condition of the chestnut trees due to the abnormal climatic conditions of the past ten years, and which have produced winter and drought injuries in many trees, it seems reasonable to believe that a return of normal conditions would be followed by a decrease in the spread of the trouble. As is stated in the Botanist's Report (q. v.), there is some reason to believe that such a decrease is already becoming apparent. It is not to be expected that trees already infected will be able to throw off the disease

noted where scars of blight cankers have partially healed), but if the disease gradually dies out as a result of natural causes, it is possible that chestnut stands will be more or less completely renewed by sprout and seedling growth free from disease.

The fact must be recognized, however, that many formerly thrifty chestnut stands have been completely destroyed and that at best only a partial natural regeneration of diseased stands can be anticipated for many years. If, then, land which has grown chestnut timber profitably in the past is to be continued as forest land, immediate measures should be taken to secure the quickest and best results. It is merely a common sense precaution on the part of the community as well as that of the owner, to make sure that land which has been the source of revenue in the past shall continue to yield at least an equal revenue in the future. From a business point of view, it is equally sensible to consider the possibility of increasing this revenue by growing the kind of timber which will produce the largest value in the shortest time.

If chestnut is the most profitable timber which can be grown where chestnut formerly grew, a fully stocked stand of this species should be established, by planting if necessary, just as soon as there is reasonable assurance of safety from the chestnut blight. If some other species than chestnut will produce quicker returns or larger profits, a considerable investment in planting such species might be warranted. Such an investment would certainly prove more profitable than to allow land formerly bearing chestnut to lie idle, or to allow it to seed up with species of small value like birch and poplar, or slow-growing species like black oak and hemlock. Even though chestnut were entirely free from disease at the present time, there are many situations where some species other than chestnut would produce better results. For instance, there are many ridges in Connecticut where chestnut does not grow to more than cordwood size in forty years. Unless very favorably situated with regard to market, such timber cannot be handled at a reasonable profit, and with a long haul to market, no profit can be anticipated. This is also true of many oak and mixed hardwood stands growing on poor soils. After cutting such timber, its replacement with a plantation of rapid growing conifers such as white pine or Scotch pine, would promise much greater returns than could be secured from natural regeneration. The greater value of the resulting

product and the shorter period necessary to produce it, would render the investment involved worth while.

Much land in Connecticut best suited for forest growth is now practically non-productive as the result of fires. Much other land formerly used for grazing or cultivation, but now reverting to forest on account of changed economic conditions, may be considered as idle land for the time being, since the present timber growth is of poor species or is too scattered to produce valuable material. All such non-productive and idle land which is better suited for forest growth than any other purpose should be made use of for forest planting with the species best adapted to the situation. This policy if systematically carried out, and followed up with intensive methods of forest management, will not only increase the productiveness of Connecticut forest lands, but will furnish many Connecticut industries with raw material which is now brought in from other states.*

With a view to advising land owners regarding the best methods of handling their forest lands, or regarding the afforestation of idle lands, the Station authorizes its foresters to make examinations without charge other than the necessary expenses for transportation, etc. Reports of such examinations give a statement of the condition of the forest land examined, and recommend a general plan for its future management. So far as possible, practical demonstrations and instructions are given for the work involved, but direct supervision cannot be furnished, nor can estimates of standing timber be made for the purpose of sale or purchase. This work rightly belongs to foresters outside the employ of the State, and such men will be recommended when desired. During the past few years the Station has supplied stock for forest planting at cost in order to encourage such work, but the development of commercial nurseries for the production of such stock at a reasonable price will relieve the Station of this necessity after the present season. The time required in attending to the nursery work and shipment of trees can be better spent in carrying on other work of the department. Assistance in securing such stock will be cheerfully rendered, however, and every effort will be made to assure satisfactory results.

RAINBOW FOREST PLANTATIONS.

Since 1902 the Connecticut Agricultural Experiment Station has conducted experiments in forest planting on a tract of land at Rainbow in the northern part of the town of Windsor. This land is part of a natural sand plain and represents one type of non-agricultural land in the state better suited for forest growing than anything else. The soil is very sandy, poor in quality and loses moisture rapidly in periods of drought.

The tract may be reached by electric car marked "Rainbow" from Hartford via Windsor. The plantations lie about one-half mile west of the village of Rainbow, between the Tariffville and East Granby highways near their junction. Mr. Henry Palmer, who lives near the Rainbow postoffice, is local superintendent and will gladly conduct visitors through the plantations.

The following descriptions of experimental plots and the accompanying map have been prepared as a guide to those who wish to examine the plantations. The knowledge thus far gained from these experiments has been included with the data from private planting in preceding pages of this report. It is anticipated that the results secured from these plantations by intensive management will prove of considerable interest and value. They will be published in future reports and bulletins of this Station.

Description of Experimental Plots.

Plot No. 1. Austrian pine, Scotch pine, European larch, Douglas fir, Chinese arbor-vitæ. Area about 1 acre. Spring 1907, east side, Austrian pine, 2-year seedlings, spacing 5 x 5 feet; middle, European larch, 2-year seedlings, spacing 5 x 6 feet; west side, Scotch pine, 2-year seedlings, spacing 5 x 5 and 6 x 6 feet. Spring 1911, area partially burned over, destroying some of each species. Spring 1913, burned area planted with 7-year Douglas

fir transplants and 6-year Chinese arbor-vitæ seedlings. This plot will show the comparative growth of several exotic conifers on poor soil.

*Plot No. 2. White pine. Area .9 acre. Spring 1907, experiment to determine comparative results of different spacing. 6x6 feet, 5x5 feet, 4x4 feet, 3x3 feet. Spring 1913, trees destroyed by fire replaced with 8-year white pine transplants.

Plot No. 3. Pitch pine. Area 1.3 acres. Spring 1902, seed sown on cultivated strips 1½ feet broad and 4 feet apart. South half of plot at rate of 2 pounds per acre, north half at rate of 1 pound per acre. Seed lightly covered by brushing the surface in both cases. Result shows that a stand of this species may be successfully established in this manner. Two pounds of seed per acre gives too dense a stand; 1½ pounds would be sufficient. Losses have not exceeded five per cent. Pitch pine is of very little commercial value in this region, however.

Plot No. 4. Red oak and white pine. Area .8 acre. Spring 1904, solid rows of oak alternating with oak and pine; spacing 6x6 feet. Oak secured by seedspot method, three acorns to a spot. 2-year white pine seedlings used. Loss small for first three years; since then oaks have been kept cut back to ground by rabbits with a few exceptions. Pines bushy and poorly formed, due to lack of crowding and attacks of white pine weevil. This mixture does not appear to be a practical one since pine grows faster and is a better tree for a sandy site than red oak. If used on such sites, oak should be given several years start.

Plot No. 5. Japanese red pine. Area 1.5 acres. Spring 1910, 2-year seedlings, spacing 6x6 feet. Failures nearly 50 per cent. the first season. Spring 1911, blanks filled with 3-year transplants. Heavy loss due to drought, following both plantings. Living stock is thrifty. Spring 1913, blanks filled with 4-year white pine transplants.

Plot No. 6. Western yellow (bull) pine. Area 2.5 acres. Spring 1908, 2-year seedlings, spacing 5x5 feet. Loss approximately 45 per cent., due to drought and fungous disease (*Peridermium pyriforme*). This is a Western species which

seems to adapt itself poorly to dry sandy soils in Connecticut, grows slowly and sustains much loss from drought. 1912, average height 1.1 feet, maximum 2 feet. Spring 1912 and 1913, blanks filled with 4-year white pine transplants.

Plot No. 7. Chestnut. Area 2.4 acres. 1902-1903, spring and fall seeding and spring planting. 1912, 10 to 15 per cent. living. Trees scattered and range in height from 2 to 4 feet. Individual development poor. The plantation is practically a failure and will be replanted.

Plot No. 8. Chestnut. Area 2.3 acres. Spring 1903, 1-year seedlings, spacing 5 x 5 feet, 6 x 6 feet, 7 x 7 feet, in three parts from south to north. Losses large and many trees show drought and winter injury. Results unsatisfactory. A few groups show fair development, individuals ranging from 3 to 5 feet in height.

Plot No. 9. Natural growth of hardwoods. Area .6 acre.

Plot No. 10. Chestnut sprouts. Area .6 acre. Natural growth, 50 to 60 years old. Trees damaged by fire and other causes were removed in 1912.

Plot No. 11. Gray birch and white pine. Area .7 acre. Scattered natural white pine reproduction underneath birch.

Plot No. 12. White pine. Area .5 acre. Spring 1902, 3-year seedlings planted under gray birch. 15 to 20 feet tall, spacing 5 x 5 feet. 1903, blanks filled with 3-year transplants of same species. Little subsequent loss and little injury by white pine weevil. 1910, birch removed from north half. 1911, birch removed from south half. Slow growth during first ten years resulted from the shade.

Plot No. 13. Natural growth of pitch pine and hardwoods. Area 1.2 acres. Spring 1910, balsam fir transplants set irregularly under pitch pine. Fir shows very little growth in three years.

Plot No. 14. Scotch pine. Area 1.2 acres. Spring 1907, 2-year seedlings planted in furrows ploughed through brush, spacing 5 x 6 feet. 1910, brush cleaned from part of plot so as to free Scotch pine. 1913, balance of plot cleaned.

Plot No. 15. White pine. Area 1 acre. Spring 1906, 3-year

Plot No. 16. Not planted. Area 3.7 acres.

Plot No. 17. Nursery site. Not planted. Area 1 acre.

Plot No. 18. Natural growth of pitch pine. Area .8 acre.

Plot No. 19. Japanese red pine. Area 1.2 acres. Spring 1910, red pine 2-year seedlings, spacing 6 x 6 feet. 50 per cent. loss the first year. May 1911, blanks filled with 3-year transplants of same species. Heavy loss the following season, due to drought as in the previous year.

Plot No. 20. White pine and Scotch pine. Area 1.5 acres. Spring 1910, 4-year white pine transplants and 2-year Scotch pine seedlings in alternate rows, spacing 5 x 5 feet, to replace hardwood trees of the previous experiment, some of which remain but were disregarded in replanting as they have grown very slowly. Some older white pines remain from planting of 1904. Loss heavy in Scotch pine as result of subsequent drought and use of slender stock grown too densely in seedbeds.

Plot No. 21. White pine and Scotch pine. Area 1.5 acres. Spring 1910, same planting as No. 20 and similar conditions.

Plot No. 22. Red pine. Area .9 acre. Spring 1902, 4-year transplants, spacing 4½ x 5 feet. Example of a practically perfect plantation. (Should be compared with other species planted the same year, Plots 23, 24, 25.) On north end of this plot white pine was used in place of red pine.

Plot No. 23. Scotch pine. Area .6 acre. Spring 1902, 3-year seedlings, spacing 4 x 5 feet. 1904, blanks and narrow space on north end filled with 2-year Scotch pine transplants. Example of practically perfect plantation. (Should be compared with other species planted same year, Plots 22, 24, 25.) 1911, trees closed together, grass shaded out and lower branches beginning to die as a result of dense shade.

Plot No. 24. Red pine and Austrian pine. Area .5 acre. Spring 1902, 4-year seedlings of red pine, spacing 4½ x 5 feet. July 1902, 4-year seedlings Austrian pine were planted on south end of plot with the same spacing. 1911, height of red pine on this plot averaged 2 feet more than on Plot 22; probably due to more protected position, better soil conditions or both. Spring 1905, north end of plot filled out with white pine.

Plot No. 25. White pine. Area .8 acre. Spring 1902, wild seedlings 8 to 18 inches tall, spacing 4½ x 5½ feet. 1903, blanks filled with white ash, green ash, basswood and tulip seedlings. 1904-1905, blanks filled with white pine wild seedlings. 1911, most of hardwoods had disappeared, stand is irregular and lacks uniformity of growth as a result of difference in quality of stock, replacing of failures several years after original planting and damage by white pine weevil.

Plot No. 26. White pine. Area 1.2 acres. Spring 1903, 2-year transplants, spacing 4 x 4 feet, 5 x 5 feet, 6 x 6 feet. Divided in three parts to determine the effect of different spacing. 1911, the closest spacing at north end apparently produced best height growth; considerable injury by white pine weevil, however, made it impossible to determine this fact absolutely by measurement of heights.

Plot No. 27. White pine. Area 1 acre. Spring 1904, two rows of pine alternating with two rows of chestnut 1-year seedlings, spacing 5 x 5 feet. Chestnut was a complete failure. 1910, failed rows filled with 4-year white pine transplants to determine possibility of using younger stock of same species for filling in established plantation.

Plot No. 28. White pine. Area 1.6 acres. Spring 1902, 3 and 4-year seedlings and transplants, spacing 4 x 5 feet. North end cultivated and fertilized for several seasons, resulting in some apparent increase in height growth. Severe injury by white pine weevil has prevented definite determination of this fact.

Plot No. 29. White pine. Area 2.3 acres. Fall 1907, 3-year transplants, spacing 5 x 5 feet. A test of fall planting. Result is a practically complete plantation, indicating that under favorable weather conditions early fall planting may succeed as well as spring planting on sandy soil.

Plot No. 30. Jack pine. Area .25 acre. Spring 1908, seedlings from Michigan, 1-2 feet tall, spacing 5 x 5 feet. Trees have grown very slowly. Species probably of small importance for eastern planting, although native to sand plains in Lake States.

Plot No. 31. Scotch pine. Area .3 acre. Spring 1904, 2-year seedlings, spacing 5 x 5 feet. In every other row the

alternate plants were green ash 1-year seedlings which subsequently died, leaving the pines 10 feet apart in the alternate rows. These blanks have been left unfilled in order to determine the effect of this wide and uneven spacing on the development of Scotch pine.

Plot No. 32. Norway spruce. Area 1.5 acres. Spring 1905, 2-year seedlings, spacing 5 x 5 feet under an open growth of pitch pine. Ground had been burned over just previous to planting. Fall 1907, another fire burned over a portion of the area. Spring 1910, part of the blanks filled with 4-year transplants Norway spruce. 1911, trees alive on 50 per cent. of the area but showed poor development, especially under dense shade. 1913, overwood partly removed so as to give Norway spruce more light, and blanks filled with 7-year transplants.

Plot No. 33. White pine. Area 1.5 acres. Spring 1905, 2-year seedlings, spacing 5 x 5 feet, under pitch pine giving medium shade. The trees are not well developed on account of shade but uninjured by white pine weevil. 1913, pitch pine thinned to give white pine more light.

Plot No. 34. Scotch pine, white pine and mountain pine. Area 1 acre. Spring 1911, 4-year transplants of Scotch pine and 3-year seedlings of mountain pine planted in alternate rows, spacing 6 x 6 feet. A large per cent. of the latter died from effect of drought the same season. Spring 1913, failures filled with 5-year white pine transplants.

Plot No. 35. White pine and Scotch pine. Area 2.3 acres. Spring 1903, original planting, 2-year white pine transplants in groups mixed with hardwood seedlings, spacing 4½ x 5 feet. Spring 1904, failures in white pine filled with 3-year transplants. Spring 1911, hardwoods mostly dead; replaced with 3-year Scotch pine transplants to determine whether the Scotch pine would overtake the older white pine.

Plot No. 36. White pine and Scotch pine. Area 1 acre. Spring 1903, original planting, 2-year white pine transplants in mixture with hard maple, spacing 6 x 6 feet. Solid rows of maple, maple and pine alternating in every other row. Maple was a complete failure. Spring 1908, blanks filled with 2 and

Plot No. 37. White pine and Scotch pine. Area 1 acre. Spring 1903, original planting same as Plot 36. Spring 1911, blanks in hardwoods filled with 3-year Scotch pine transplants.

Plot No. 38. White pine, Douglas fir. Area .4 acre. Spring 1903, pine and fir planted on most of the plot and pine alone at the north end. Spacing is very irregular, due to failure of hardwoods planted in the original experiment; blanks not filled; plantation left for comparison of pine and fir.

Plot No. 39. White pine. Area .7 acre. Spring 1903, ash, maple and other hardwoods alternating with pine, original spacing 5 x 5 feet. Hardwoods have failed, leaving pine with present spacing of 10 x 10 feet, which will be left to demonstrate the effect of wide spacing on growth and condition of the trees.

Plot No. 40. Red oak. Area 1 acre. Spring 1903, red oak acorns planted in spots, 1 acorn in each spot, on northerly half of plot, with spacing 5 x 5 feet. On the southerly half of plot 2 acorns were planted in each spot with a spacing of 6 x 6 feet. 1904, failed places were filled. 1907, brush cleaned from entire plot. 1911, one-third of the trees showed injury by rabbits.

Plot No. 41. White pine and Norway spruce. Area .25 acre. Spring 1906, pine and spruce 2-year seedlings in alternate rows, spacing 5 x 6 feet. Most of the trees were planted under light brush and show effect of the competing growth by more slender forms. Best development secured where no brush was present.

Plot No. 42. White pine and Norway spruce. Area 2.7 acres. Spring 1906, alternate rows of pine and spruce 2-year seedlings, spacing 5 x 6 feet under a medium dense growth of birch and pitch pine on most of the area, but varying to open growth and scattered trees at north end of plot. March and April 1911, overwood removed from south half and subsequently the spruce and pine suffered considerable injury from late frost, exposure and drought. May 1911, blanks filled with 5-year white pine transplants.

Plot No. 43. White pine and Norway spruce. Area 4.25 acres. Spring 1906, same experiment as Plot 42 but overwood not removed.

Plot No. 44. White pine. Area 3.2 acres. Spring 1906,

on west side where white pine was planted pure, spacing 5 x 6 feet. Medium dense overwood of birch and pitch pine on about half of area. Most of maples failed. Spring 1910, blanks filled with 4-year white pine transplants.

Plot No. 45. *Mountain pine.* Area 4.5 acres. *Spring 1912*, 3-year transplants, spacing 6 x 6 feet. Heavy losses during subsequent dry summer. A few scattered Corsican pines are left from an unsuccessful planting of 1910.

Plot No. 46. White pine and Norway spruce. Area .7 acre. Spring 1906, pine and spruce 2-year seedlings in alternate rows, spacing 5 x 6 feet. May 1908, blanks filled with jack pine.

Plot No. 47. Douglas fir and jack pine. Area 1 acre. Spring 1903, Douglas fir and various hardwoods in an irregular mixture, spacing 5 x 5 feet. Hardwoods mostly failed. Spring 1908, blanks filled with jack pine.

Plot No. 48. Red oak and white pine. Area 1 acre. Spring 1904, oak 1-year seedlings, pine 2-year seedlings; four rows of oak and two rows of pine, spacing 6 x 6 feet. Plantation shows good growth but the red oak is too branchy and not always straight in form. 1911, pines were outstripping the oaks in growth.

Plot No. 49. Pitch pine. Area 1 acre. Spring 1903, 2-year seedlings, spacing 5 x 5 feet. 1911, 94 per cent. living.

Plot No. 50. Red oak. Area 1 acre. Spring 1904. 1-year seedlings, spacing 6 x 6 feet. *1911*, 90 per cent. living but very few well developed. The site is too poor and dry. Rabbits have done much damage.

Plot No. 51. Red oak and white pine. Area 1 acre. Spring 1904, oak 1-year seedlings and pine 2-year seedlings; two rows oak, one row pine, spacing 6 x 6 feet. Growth and form of trees generally poor.

Plot No. 52. Japanese red pine and white pine. Area 1 acre. Spring 1910, 2-year seedlings of each species in alternate rows, spacing 6 x 6 feet. Losses were very heavy, the red pine being winter-killed and both species suffering severely from drought during the seasons of 1910-1912.

Plot No. 53. White pine. Area .3 acre. Spring 1905, 2-year seedlings, spacing 5 x 5 feet. Spring 1910, blanks filled with 3-year white pine transplants.

Plot No. 54. White pine and Japanese black pine. Area .9 acre. Spring 1910, white pine 3-year transplants, black pine 2-year seedlings in alternate rows, spacing 6 x 6 feet.

Plot No. 55. White pine. Area 1 acre. Spring 1903. 2-year seedlings in mixture with beech. Spacing 6 x 6 feet. 1904, failures in pine replaced with 3-year transplants. The beech is a failure and the remaining pine is too far apart for best development.

Plot No. 56. White pine and Scotch pine. Area 1 acre. Spring 1903, 2-year seedlings, pine alternating with beech and every other row solid beech. Spring 1911, the beech having *failed was replaced with Scotch pine 3-year transplants.*

Plot No. 57. Chestnut and beech. Area 1 acre. Spring 1903, seedlings planted alternately in rows, spacing 5 x 5 feet. 1904, failures replaced with seedling stock. 1911, some trees of each species living but poorly formed and plantation is practically a failure, the site being too poor for these species.

Plot No. 58. Black locust. Area 1 acre. Spring 1903, 1-year seedlings, spacing 4 x 4, 5 x 5, and 6 x 6 feet. Many trees were girdled and killed by rabbits. Trees on north end have grown fastest. In 1911 these ranged from 15 to 25 feet in height and 1 to 5 inches in diameter breast high. Nearly all seriously injured by the locust borer.

Plot No. 59. White pine, black birch. Area about 1.1 acres. Spring 1903, 2-year transplants, spacing 5 x 5 feet at south end of plot. Spring 1904, white pine 3-year transplants alternating with black birch nursery seedlings, spacing 5 x 5 feet on balance of plot. Black birch has failed or grown very slowly and present wide spacing of pine has resulted in poor development.

Plot No. 60. White pine. Area 2 acres. Spring 1905, 2-year seedlings and 3-year transplants, part set in furrows and part on hills between, spacing 5 x 5 feet.

Plot No. 61. White pine. Area about 2 acres. Spring 1913, [illegible] transplants partly in and partly between old furrows

spacing 5 x 6 feet. A few chestnut trees left from planting of 1905 were ignored in replanting because so small and poorly developed.

Plot No. 62. White pine. Area 5.7 acres. Spring 1907, 2-year seedlings, spacing 5 x 5 feet. Very few failures.

Plot No. 63. Area 2.4 acres. Not planted.

Plot No. 64. Scotch pine. Area 1.3 acres. Spring 1910, 2-year seedlings, spacing 6 x 6 feet. A few chestnut trees remain from a previous planting.

Plot No. 65. Area .8 acre. Not planted.

Plot No. 66. Western yellow (bull) pine. Area 1.6 acres. Spring 1908, 2-year seedlings, spacing 5 x 5 feet. Conditions similar to that of Plot No. 6. Some loss from fungous trouble (*Peridermium pyriforme*).

Plot No. 67. Area .2 acre. Scattered natural growth of pitch pine.

Plot No. 68. White pine. Area 4.4 acres. Spring 1905, collected wild stock from Stafford, 2-year nursery seedlings and 3-year transplants, spacing 5 x 5 and 6 x 6 feet. Height growth varies greatly in different parts of the plot with the age, size and quality of stock, and variation in site conditions.

Plot No. 69. White pine and Norway spruce. Area 4 acres. Spring 1905, 2-year seedlings of pine alternating in each row with 2-year seedlings of spruce, spacing 5 x 5 feet. Norway spruce does not equal white pine in height growth on this sandy, dry site and suffers greater loss.

Plot No. 70. Austrian pine. Area 1 acre. Spring 1908, 2-year seedlings, spacing 6 x 6 feet. 1912, most of the trees suffered severely from drought; very few show good development.

List of Experimental Plots.

Plot	1,	formerly	A1	Scotch pine, Austrian pine, European larch, Douglas fir, Chinese arborvitæ, Norway spruce, white pine, pitch pine.
"	2,	"	A2	White pine.
"	3,	"	A3	Pitch pine.
"	4,	"	A4	Red oak, white pine.
"	5,	"	A5	Japanese red pine, white pine.
"	6,	"	A6	Western yellow pine, white pine.
"	7,	"	A7	Chestnut—scattering.
"	8,	"	A8	Chestnut.
"	9,		—	Chestnut and other hardwoods—natural growth.
"	10,		—	Chestnut.
"	11,		—	Gray birch.
"	12,	"	A9	White pine.
"	13,		—	Pitch pine, balsam fir.
"	14,		—	Scotch pine.
"	15,	"	B15	White pine.
"	16,		—	Not planted.
"	17,		—	Nursery site.
"	18,		—	Pitch pine.
"	19,	"	B14	Japanese red pine.
"	20,	"	B13	White pine, Scotch pine.
"	21,	"	B12	White pine, Scotch pine.
"	22,	"	B11	Red pine.
"	23,	"	B10	Scotch pine.
"	24,	"	B9	Red pine, Austrian pine, white pine.
"	25,	"	B8	White pine.
"	26,	"	B7	White pine.
"	27,	"	B6	White pine.
"	28,	"	B5	White pine.
"	29,	"	B4 & B3	White pine.
"	30,	"	B2	Jack pine.
"	31,	"	B1	Scotch pine.
"	32,	"	BC1	Norway spruce.
"	33,	"	BC2	White pine.
"	34,	"	C1	Scotch pine, white pine, mountain pine.
"	35,	"	C2	White pine, Scotch pine.
"	36,	"	C3 (East)	White pine, Scotch pine.
"	37,	"	C3 (West)	White pine, Scotch pine.
"	38,	"	C4	White pine, Douglas fir.
"	39,	"	C5	White pine.
"	40,	"	C6	Red oak.
"	41,		—	White pine, Norway spruce.
"	42,	"	D7 (East)	White pine, Norway spruce.
"	43,	"	D7 (Center)	White pine, Norway spruce.

Plot 44,	formerly	D7 (West)	White pine.
" 45,	"	D8	Mountain pine, Corsican pine.
" 46,	"	D7	White pine, jack pine, Norway spruce.
" 47,	"	D6	Jack pine, Douglas fir.
" 48,	"	D5	White pine, red oak.
" 49,	"	D4	Pitch pine.
" 50,	"	D3	Red oak.
" 51,	"	D2	White pine, red oak.
" 52,	"	D1	Japanese red pine, white pine.
" 53,	"	DE1	White pine.
" 54,	"	DE2	Japanese black pine, white pine.
" 55,	"	E1	White pine.
" 56,	"	E2	White pine, Scotch pine.
" 57,	"	E3	Chestnut, beech.
" 58,	"	E4	Black locust.
" 59,	"	E5	White pine, black birch.
" 60,	"	E6	White pine.
" 61,	"	E7	White pine, chestnut.
" 62,	"	F5	White pine.
" 63,	"	F4	Not planted.
" 64,	"	F4	Scotch pine.
" 65,	"	F4	Not planted.
" 66,	"	F4	Western yellow pine.
" 67,		—	Pitch pine.
" 68,	"	F3	White pine.
" 69,	"	F2	White pine, Norway spruce.
" 70,	"	F1	Austrian pine.

List of Species Used on Experimental Plots.

PINES.

Austrian Pine, *Pinus Laricio, var. austriaca.*

A native of Europe, where it is grown to some extent for timber; well adapted to dry, sandy soils. Plots 1, 24, 70.

Bull (Western Yellow) Pine, *Pinus ponderosa.*

A common timber tree of the western United States; usually found in dry situations. Plots 6, 66.

Corsican Pine, *Pinus Laricio.*

A native of southern Europe, where it attains large size, but is not hardy in New England. Plot 45.

Jack Pine, *Pinus divaricata.*

A native of Canada and the northern border of the United States; especially fond of sterile, sandy soils. Plots 30, 46, 47.

JAPANESE BLACK PINE, *Pinus Thunbergii.*

A native of China and Korea; used successfully in Japan for planting on sand plains. Plot 54.

JAPANESE RED PINE, *Pinus densiflora.*

A native of the mountains of Japan, where is grows to large size. Plots 5, 19, 52.

MOUNTAIN PINE, *Pinus montana.*

Native to the mountains of central Europe, where it does not attain large size. Plots 34, 45.

NORWAY PINE, *Pinus resinosa* (see red pine).

PITCH PINE, *Pinus rigida.*

The native yellow pine of New England, which reaches its best development further south; grows well on sandy soils, but is not of much commercial importance in this region. Plots 1, 3, 13, 18, 32, 33, 42, 43, 44, 49, 67.

RED (NORWAY) PINE, *Pinus resinosa.*

A handsome tree native to the northeastern United States and Canada; is almost entirely free from insect troubles, and has great possibilities for reforestation purposes. Plots 22, 24.

SCOTCH PINE, *Pinus sylvestris.*

The timber pine of Europe, especially well suited to dry, sandy situations. Plots 1, 14, 20, 21, 23, 31, 34, 35, 36, 37, 64.

WESTERN YELLOW PINE, *Pinus ponderosa* (see bull pine).

WHITE PINE, *Pinus strobus.*

The most valuable and adaptable of all pines; is native to this region and grows rapidly on light soils. In spite of its insect enemies and susceptibility to fire damage, it promises the best returns as a forest investment. Plots 1, 2, 4, 11, 12, 19, 20, 21, 25, 26, 27, 28, 29, 33, 34, 35, 36, 37, 38, 39, 41, 42, 43, 44, 46, 48, 51, 52, 53, 54, 56, 59, 60, 61, 62, 68, 69.

OTHER CONIFERS.

ARBOR-VITAE, CHINESE, *Biota orientalis.*

Native to the mountains of northern China. Plot 1.

FIR, BALSAM, *Abies balsamea.*

Native to northern United States and Canada. Plot 13.

FIR, RED, *Pseudotsuga taxifolia.*

One of the best timber trees of the Rocky Mountains and Pacific Coast States. Only the mountain form is hardy in this region. Plots 1, 38, 47.

LARCH, EUROPEAN, *Larix europaea.*

A species native to the mountains of central Europe. Plot 1.

SPRUCE, DOUGLAS, *Pseudotsuga taxifolia* (see red fir).

SPRUCE, NORWAY, *Picea excelsa.*

The common timber spruce of Europe. Plots 32, 41, 42, 43, 46, 69.

HARDWOODS.

BEECH, AMERICAN, *Fagus americana.*

A native tree of the northern United States and Canada; does not thrive on light sandy soils. Plot 57.

BIRCH, BLACK, *Betula lenta.*

Native to this region but not well suited for light sandy soils. Plot 59.

BIRCH, GRAY, *Betula populifolia.*

The common birch of old fields; thrives on dry soils, especially after vegetation has been removed by cultivation or burning. Plots 11, 42, 43, 44.

CHESTNUT, *Castanea dentata.*

The most common and useful timber tree of Connecticut in the past; establishes itself with difficulty on light sandy soils. Plots 8, 10, 57, 61, 64.

LOCUST, BLACK, *Robinia pseudacacia.*

A native species which thrives on poor soils, but is subject to injury by borers. Plots 17, 58.

OAK, RED, *Quercus rubra.*

The most rapid growing native oak; does fairly well on sandy soils. Plots 4, 40, 48, 50, 51.

OAK, WHITE, *Quercus alba.*

The most valuable native oak; of very slow growth, and not attractive for forest planting, especially on sandy soils. Plots 13, 17.

FOREST PLANTING IN CONNECTICUT.

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The Progress of Forest Planting.

Statistics recently gathered indicate that approximately 4,000 acres of land in Connecticut have been planted with forest trees since 1900. Forest planting for the purpose of making non-agricultural land productive of a profitable crop of timber is a very recent development in Connecticut, but is receiving more attention yearly, both in this and other states. Prior to 1900 a few land owners had planted small tracts, which were described in a previous report of the Station Forester.* At that time it was estimated that 635,000 trees had been set in recent commercial plantations, covering approximately 500 acres. Since then increasing interest has been shown each year in forest planting.

In order to determine the progress more definitely, circular letters were sent out in November, 1911, requesting a report from those known to have planted forest trees, and forms furnished for detailed records of all forest plantations. Returns were received from a little more than fifty per cent. of the owners and, with information previously secured, a record of two-thirds of the forest plantations established in Connecticut since 1901 was compiled. These returns have furnished much interesting information concerning different phases of planting, which will be presented in this report. Table I gives a summary of forest planting, by counties:

* Part IV, Biennial Report of the Connecticut Agricultural Experiment Station, 1907.

*TABLE I.

A Summary of Forest Planting in Connecticut Previous to 1912.

Compiled from Reports of Owners in November 1911 and from Records in the State Forester's Office.

Name of County.	Area Planted. (Acres.)	Number of Trees Planted. Conifers.	Broad Leaf Deciduous Trees.	Species Not Separated.	Number of Land Owners Who Planted.	Range in Area of Individual Plantations. (Acres.)	Number of Towns Where Planting Was Done.
....	122.5	115,800	2,000	....	18	.5– 60	9
....	478.	540,400	†112,400	....	16	2.5–214	11
....	212.	269,850	6,400	....	17	1.0– 75	14
....	121.5	39,300	85,300	....	2	4.5–117	4
....	604.	570,550	78,900	‡160,000	12	2.0–227	13
....	92.5	47,000	....	....	8	1.0– 30	4
....	552.	529,300	....	....	10	1.0–400	10
....	110.5	158,500	....	....	18	1.0– 20	10
....	2293.0	2,270,700	285,000	160,000	101	.5–400	75

mber of trees planted, 2,715,700.

ıot include planting on State lands by State Forester.

ition there were 23½ bushels of seed used direct in reforestation on planting sites.

conifers but the number of each not given.

les some planting done by Union landowners in Woodstock and Ashford, Windham County.

According to the above table 2,715,700 trees have been planted and 2,293 acres forested with commercial species of forest trees. It may be assumed, since this represents two-thirds of those plantations known to have been established, that the whole acreage at the end of 1911 was 3,439.5. In the spring of 1912 the Connecticut Agricultural Experiment Station furnished 500,000 trees at cost for private owners who desired to plant forest. No record is available of the stock furnished by private nursery companies. With this added area planted in 1912, it is probable that not less than 4,000 acres of private forest have been established by planting within the past decade. This area is small in comparison with the large area of unproductive non-agricultural land in this state, but considering the lack of knowledge concerning the nature and value of forest planting and the difficulties of any new task, this progress is excellent.

TABLE II.

Area (Acres)	1–10	11–25	26–50	51–75	76–100	Over 100	Total
*Number of Plantations	70	17	4	3	0	7	101

In Table II the various plantations of which record was secured are classified according to area. They are located in all parts of the state and, as shown above, the majority are twenty-five acres or less in extent. The following seven land owners have planted more than 100 acres each:

A. B. & J. C. Wells, Southbridge, Mass. Plantations in Union, Ashford, and Woodstock, Conn.	400	acres
Harris Whittemore, Middlebury	227	"
Hartford Water Board, City of Hartford	214	"
Ansonia Water Company, Ansonia	165	"
New Haven Water Company, New Haven	142	"
Middletown Water Commission, City of Middletown	117	"
Isaiah Baker, Jr., Hartford	104	"

In nearly all cases, owners begin with a few thousand trees, perhaps only enough for one acre, twelve hundred trees, and then keep planting more each year. Experience with a small number at the beginning tends to ensure success then and in

*All planting done by one landowner is considered a single plantation in this record.

subsequent planting. A high percentage alive at the end of the first season is an indication that the planting was well done. Instances of complete or nearly complete failure are very few and these are usually traceable to a definite cause, such as heated stock, carelessness in handling, protracted drought following planting, etc. The majority of the plantations have been successful, the average showing a little more than 70 per cent. living—enough to ensure a good future forest crop. Many of the plantations range from 80 to 95 per cent. of trees alive and thrifty.

Initial cost is an important factor in final profit. The total cost per acre has seemed excessive in only five instances, when it ranged from $20.00 to $40.00 per acre. In the returns, the cost of planting (including cost of trees, labor and incidentals) was not always furnished. Such costs as were given are classified as follows:— (1) Those $15.00 per acre or less. (2) Those exceeding $15.00 per acre. The average cost per acre for planting for (1) was $9.68; for (2) $20.78. The average of all costs included under (1) and (2) was $11.86. Such a result may be considered very low since it is generally conceded that successful forest planting usually requires an expenditure of from $10.00 to $15.00 per acre according to conditions.

The principal species of conifers planted was white pine; to a less extent red or Norway pine, Scotch pine, Austrian pine and Norway spruce were used. The kinds of broadleaf deciduous trees chiefly used were oaks, hickories, maples and white ash.

The mistakes as well as the successful practice of forest planting by private land owners during the past ten years furnish information of value to all who undertake planting. The following discussion of forest planting embodies the experience thus gained and may serve as a guide for future work.

Information and Instructions Regarding Forest Planting.

Planting Sites:

In general, forest planting should be confined to non-agricultural lands. Other lands will usually be required for field crops, for fruit-growing or for grazing, especially in view of the present growth of agriculture in the state. Increasing population will eventually demand the use of all lands profitable for

the production of food. There will remain, however, not less than a million acres of non-agricultural land for natural or planted forest in Connecticut. Much land is without forest to-day which is fit only for forest growing, and there are some tracts now in woodland that will be cleared and devoted to agricultural development. The character of the soil and topography, accessibility to market, etc., are some of the factors determining future use of land. Forest planting will be an important part of the practice of forestry in making non-agricultural lands productive, and in renewing forest growth where fire and the chestnut bark disease have killed the trees.

The following classes of sites have been recognized in forest planting of the past decade:—

(1) *Open pasture land of poor quality* and farm land found to be unfit and unprofitable for such purpose because too steep, too stony, too thin or poor in soil, or otherwise unsuited for anything except forest growth. Nearly every farm has a greater or less area of this type of land. The owner is paying taxes on it yearly and receiving no income.

(2) *Brush land.* Under this heading those lands may be classed which, through cutting of the forest and subsequent fires, or on account of fire alone, have grown up to low, worthless brush or inferior trees. Brush pastures more recently abandoned may be included in this group, as well as formerly tilled fields that have proved unproductive and lie idle.

(3) *Recently cut-over sprout lands* incompletely stocked with valuable forest species. These should be planted with a sufficient number of trees to ensure complete use of the land and to supplement natural seedlings and sprouts, in order to produce a full yield of timber of good quality.

(4) *Woodland.* Open woodland, only partially stocked with forest, should be underplanted to secure a full yield and to improve forest conditions. Forests in which all the trees have been killed by fire or by the chestnut disease should be cut clean, the slash disposed of by burning and the land planted with conifers.

Plantations have been successfully started and are thriving to-day on all these types of planting sites.

Species:

Both conifers and broadleaf deciduous trees have found a place in past planting. The following list comprises those in private plantations of which the Station has secured a record. The arrangement is somewhat in accordance with their relative importance and the number planted.

Conifers	*Broadleaf Deciduous Trees*
White pine	White ash
Red pine	Sugar maple
Scotch pine	Oaks, red and black
Norway spruce	Tulip tree (whitewood)
European larch	Catalpa
Douglas fir	Black locust
Austrian pine	Chestnut
Hemlock	Oaks, white and swamp white
Balsam fir	

Broadly speaking, conifers should be chosen in preference to broadleaf species for forest planting in Connecticut. Natural woodland is chiefly composed of broadleaf deciduous trees, the so-called hardwoods, and under better management these forest areas will produce much useful timber of that kind. For the most part, lands requiring forest planting are poor in quality and better suited to growing conifers, such as pines, which require less from the soil than broadleaf trees. Conifers endure drought and maintain themselves on relatively dry, thin soils, or very sandy soils where hardwoods would be liable to fail. In yield, they exceed hardwoods in quantity per acre at the same age, and there will always be an excellent market for the material grown. Broadleaf trees may be selected, however, for planting on certain classes of sites for which they are specially adapted, or to produce hardwood material desired by the owner, or to use in mixture with conifers in planting.

Of the conifers, white, red and Scotch pines are to be preferred for commerical plantations; of the broadleaf trees, white ash, red oak, tulip tree and sugar maple deserve consideration. In underplanting woodland it must be remembered that Scotch pine requires plenty of light for development, red pine can endure a little more shade, and white pine still more; good development depends, however, upon ample light and growing

space. During the first ten years the rate of growth of white pine under medium shade of birch is one-half what it is in the open, according to experiments in the Rainbow plantations. White pine and red pine seem equally good species for Connecticut. They do well on a variety of soils and situations. On the better classes of soil, red pine equals or surpasses white pine in growth of the first ten years but on poor sandy soil it falls a little behind white pine. Red pine is not attacked by the pine weevil, which injures the leading shoot of white pine in some parts of the state. In case the weevil does considerable damage in a locality it may be better to choose red pine for planting or making a plantation of the two in equal mixtures. They are equally well adapted for growth together, or for growth in pure forest. Scotch pine should be confined to poorer, drier sites, especially sands. This species is the fastest growing of the pines and on dry, sandy soil has grown 10-16.5 feet in ten years from planting. On better classes of soils, Scotch pine is likely to grow so fast that the wood will be coarse and hence less valuable.

Norway spruce should be planted only on better classes of forest soils having fair moisture content, and not on low, wet, poorly drained soils. Such sites are frosty, and Norway spruce has proven susceptible to late frost injury. It is probably better adapted to the northern part of Connecticut than to the southern half.

Austrian pine is not specially recommended; other pines will furnish better products when grown.

Douglas fir, known also as Douglas spruce and Oregon pine, cannot yet be recommended with certainty. The hardy species from Rocky Mountain, and not from Pacific Coast seed, has made fair growth on medium quality soils, although not as rapid as white pine. On dry sandy soils its early growth is very slow, but after eight or nine years it begins to make greater annual height growth. This species is worth thorough trial, and is being experimented with at Rainbow.

Neither hemlock nor balsam fir are promising species for planting, as the wood of both is coarse-grained and of low value. Hemlock is also slow growing, and balsam fir short-lived. White ash and tulip tree are worth consideration for moist but not

swampy sites, where the production of these two kinds of wood is desired.

Red oak, and possibly black (yellow) oak also, are useful in reforestation, but are not very fast growers. Plantations may be started from seed in spots or by setting seedlings. Sugar maple, being tolerant of shade, may be useful in mixture with other species and deserves more attention for the establishment of sugar groves in the state.

The planting of chestnut is not recommended until the probable outcome of the chestnut disease is known. Black locust is not recommended because of serious injury by the locust borer. Its ability to spread by seed and by root suckers makes it somewhat objectionable on the farm. White oaks are probably too slow in growth to be profitable for general planting.

A plantation of catalpa near Mystic on fairly good soil has done well in its early growth. This species is liable to winter-killing in most parts of the state, and is reported as doing poorly in Groton, Winchester and Windsor. A plantation, 27 years old, in the town of Fairfield has not made a valuable growth; the trees are not straight and well developed. Pine and larch have done much better in that locality. Most of the sites requiring reforestation are too poor in quality to develop catalpa well. Its final product, also, is not likely to be of much use excepting for posts and small poles, for which its durable wood is well suited.

Season of planting.

Early spring planting of conifers has proven, on the whole, better than fall planting, although there have been some successful instances of the latter. If fall planting is done it should be in the first half of September, so that the roots may have a little growth in their new place before winter. Fall planted stock is generally subject to some drying out; to injury by heavy wet snows since it has little root-hold on the soil; and to heaving out by frost action in the early spring. Broadleaf deciduous trees may be planted in the fall or in the spring, but there is less danger from gnawing animals if planted in the spring.

Spring planting is most successful when the work is started just as soon as the frost is well out of the ground, and the soil

in condition to handle readily. Later, the heat tends to increase transpiration from the needles beyond the ability of the newly-set roots to furnish moisture, hence the plant simply dries out and dies. In one instance, late planting resulted in only a small per cent. of the trees being alive at the end of the season. Because it puts out its foliage so early, European larch should be planted very early in the spring or else in the fall. In an average season, the work of forest planting ought to be completed by the first week in May in order that the little trees may be benefited by the spring rains and become rooted before the new growth starts.

Size and Age of Trees for Forest Planting.

In general, one-year-old seedlings of broadleaf deciduous trees are sufficiently large for forest planting and their height varies according to species, etc., from six inches to twenty-four inches. Commercial nurseries often grade their stock according to height.

There are two classes of coniferous nursery stock for forest planting which may be distinguished: namely, seedlings and transplants. Seedlings are those trees grown from seed in beds or in drills until taken up and sent out for planting. Transplants are seedlings which have been transferred from seedbeds to nursery lines in order to develop more stocky tops and more vigorous, compact root systems. Seedlings of conifers used in forest planting are generally two years old, less frequently three years; transplants are three or four years old, more commonly three years. Seedlings are usually transplanted in the nursery when two years old and kept in nursery lines for one or two years. In all forest planting the trees should be young and have a small top and compact root system, with many fibrous roots, in place of long straggling ones. With the use of small trees the initial cost of planting is reduced and a larger per cent. survive. This principle has often been misunderstood in the past. Landowners have spent unnecessary money in establishing forest with trees three to six feet tall, and have not secured the advantage and success anticipated from the use of such large stock.

Two-year-old seedlings of white pine and red pine range from four inches to six inches in height. In years when abundant moisture was well distributed through the growing season, and on sites where competition of other growth was not severe,

this size and age have been satisfactory. However, in seasons of drought, such as have been experienced in recent years, many failures in plantations have resulted from the use of two-year seedlings. Three-year-old transplants have generally done much better under such conditions. They range from five inches to eight inches in height and have a better root system as a result of transplanting. Four-year-old stock is larger, more costly, increases the labor and hence the cost of planting. This stock should be used only on sites where the plants have to meet strong competition or other special conditions, and as fillers for failed places in older plantations.

Two-year-old Scotch pine seedlings range from six inches to twelve inches in height and have strong roots. Trees of this age and size are suitable for planting and the use of transplanted Scotch pine is unnecessary in most cases. In one instance on a hot, dry, sandy site, there was heavy loss of two-year Scotch pines due to intense radiation of heat from the surface of the sand resulting in injury to the tender bark near the base. These trees had been grown too close together in the seedbed; they were slender and the bark tissues not thickened as in more open beds. Two-year transplants of Scotch pine are better suited for very dry, sandy sites.

Three or four-year-old transplants should be used when planting Norway spruce or Douglas fir. One-year or two-year-old seedlings are suitable for forest planting in the case of European larch.

The Source of Trees for Planting and their Care.

The Connecticut Agricultural Experiment Station has for a number of years furnished private owners with trees at cost for forest planting in the state, or procured them elsewhere for the same purpose. The table below gives the total number of trees distributed annually to private owners to stimulate forest planting. This was only a temporary policy, because suitable stock could not be procured otherwise during these years at reasonable prices by prospective forest planters. It will probably be given up after 1913 since private forest nursery companies will then be fully able to meet the demand with the right kind of stock and at fair prices.

TABLE III.

Distribution of Trees for Forest Planting.

Connecticut Agricultural Experiment Station.

Year.	Number of Trees.
1908	300,000
1909	300,000
1910	463,000
1911	302,000
1912	672,000
Total	2,037,000

Some of these trees were procured from Germany, but this practice was discontinued because the white pine blister rust was thus introduced. Since then the United States Secretary of Agriculture, under authority from Congress, has prohibited the importation of pines because of danger from disease and insects. In any event, stock grown in Connecticut or New England is to be preferred because of short distance and time required in shipment. Pines are usually shipped from the nursery in boxes containing bundles of fifty or one hundred trees each, and as soon as received the trees should be "heeled in" near the planting ground. After cutting the cord on a bundle so that plants may be separated, the roots should be dipped in water and the plants placed upright in a trench having one straight side, the earth being packed firmly around the roots. If soil next to the roots is watered occasionally, the trees may be kept in this manner for a week or more if necessary, when conditions are not right for immediate planting. They should be shaded with boughs or heeled in, in some shady place if planting is long delayed.

Number of Trees required per Acre.

The general rule for spacing trees in a forest plantation is to plant them sufficiently close so that they will crowd each other and develop tall, clean boles. This spacing must not be too close, however, or the trees will be so crowded as to stunt their growth, and the initial cost of the plantation will be increased considerably because of the greater number of trees used. According to species and conditions of site, the spacing

varies from $4' \times 4'$ to $6' \times 6'$. Nearly all the plantations in Connecticut have been spaced $6' \times 6'$; some, however, being $5' \times 5'$, or $5' \times 6'$. A spacing of $6' \times 6'$, requiring 1,210 trees per acre, is best from the standpoint of economy and will produce good forest conditions as well as satisfactory development of individual trees. A wider spacing results in branchy trunks and lumber of poor quality. This effect of wider spacing has been demonstrated in plantations in Connecticut and elsewhere in New England.

On very brushy land, or on rocky sites, the full number per acre cannot be set, nor in planting poorly stocked cut-over land or in underplanting woodland. When such planting is undertaken advice should be sought from the forester of the Experiment Station, or from private foresters, to determine the density of planting and the subsequent cutting necessary to give underplanted trees proper development.

Preparation of the Site.

Usually preliminary preparation of the whole site is not possible, and it is neither necessary nor advisable. Furrows six feet apart in which to set trees are sometimes plowed on heavy sod land which is relatively level. Furrowing on slopes is a bad practice because there is great danger of surface water-flow washing out the soil and plants along the furrow. Furthermore, a planting site on a steep slope does not require such treatment since grass growth on it is usually light or interrupted.

Removal of brush renders planting easier and a little cheaper, but is expensive and generally not warranted by existing conditions. On the majority of sites, brush is not dense, or may be grubbed out at the spot where the tree is set. Although brush may somewhat hinder plants in growth at the outset by shading or crowding, yet it protects against late frost injury and tends to check evaporation from the soil. Treatment of such sites subsequent to planting will be discussed later on.

Methods of Planting.

Trees should be set at a slightly greater depth than they were in the nursery. Whatever the method, two essential things must be kept in mind by the foreman of the work: (1) that the roots should be protected at all times from drying out, either

by carrying the trees in a pail containing water or in a basket with wet sphagnum moss; (2) that the trees should be firmly set in the soil without waste motions, yet with proper care. The mattock or grub hoe has proved to be the best tool.

The slit method has been practiced successfully on sites where there is little brush and a light grass growth, and where the soil is not hard. A square foot of sod is skinned off with a few strokes of the mattock. The blade is then struck down squarely into the ground to its full depth, the handle is raised and with the same motion twisted to one side slightly so as to open the ground at the edge and end of the mattock blade. Into this hole the tree is inserted in an upright position, the mattock then removed and the earth trodden firm with the foot. In this method an extra man or boy keeps from three to five planters supplied with trees as they need them, one tree at a time. A modification of this method, seen in practice on light soil, is to strike the mattock into the ground and, grasping the handle near the end, pull, thus opening a hole at the back of the blade. The tree is thrust to the proper depth into this hole, pressed to one side so as to straighten it up, the mattock removed and the earth firmed by the foot.

In some planting observed by the writer the grass was not scraped off from the spot where each tree was set. There was not a heavy sod, and trees similarly planted the year previous on adjoining land had sustained few losses in number. Removal of the sod is, however, recommended strongly by one authority,* and is probably a safer policy where competing grass, etc., may drain the moisture away from the tree roots or hinder access of water to the soil. Planting is rapid by the slit method. Care must be taken to put the tree at the right depth, to get the roots down into the hole and to leave the tree upright. If the work is not closely supervised, it tends to be careless. In one operation on a hilly site, careless planting under the modified method mentioned above left the trees nearly prostrate in position. The cause is evident: when the planters were working down hill, the tendency was to drive the mattock into the ground at an angle much less than the required right angle (i. e. perpendicular to the surface), the tree was thrust in, the ground

* Hawes and Hawley, Forestry in New England, 1912.

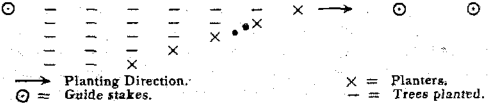
tramped down and the tree inclined in each case down hill. Such planting was shallow, leaving the roots subject to drying out, and if the trees live, the lower part of the bole will be curved as it endeavors to assume an upright position. Heavy moist snowfalls will tend to further deform trees so planted.

The hole method consists in digging a hole with a mattock after cleaning off a square foot of sod, and setting the tree in this hole. Pairs of laborers are engaged under this method. Those digging holes immediately precede those planting trees. Each planter may carry a pail containing a few inches of water in which the trees are placed upright, or two planters have such a pail between them. An extra laborer keeps the pails replenished. The practice of one laborer laying a tree in each hole in advance of those planting is condemned. It exposes the roots to drying out and under this practice trees are often left lying unplanted in the holes. It is better to have each laborer take a fresh tree from the pail as he needs it. In digging the holes, care must be taken not to scatter the earth, but leave it heaped up close to the hole. The size of the hole depends on the root system of the tree. Generally a hole five or six inches broad and deep is ample. Holes should not be made until just before the planter is ready to set the trees, because under usual conditions the soil in the hole dries out quickly and the roots will then be in contact with dry instead of fresh soil.

In planting, the laborer holds the tree in position at proper depth with his left hand, scoops a few handfuls of earth over the roots and presses it down on all sides with his hands. He then scrapes the rest of the soil into the hole with a few quick motions and tramps it firm with his feet. In doing this care has to be taken not to skin the bark off the stem, and to leave the tree upright in position. Firming the soil is essential to prevent leaving air spaces about the roots which will cause them to dry out and die. Careless planting is more likely to result thus with the hole method than with the slit method. Laborers are likely to grow careless toward the latter part of the day or fail to use care at all times unless closely supervised.

In the hole method, a fine-grained clayey soil will bake and evaporate moisture more or less rapidly. To avoid this the soil may be shredded roughly and spread, grass side down,

this is less essential. In the finer-grained soils capable of holding much moisture, there is danger of the plants being heaved out of the soil the spring of the second year, one year after planting. Such soils expand and contract much with alternate freezing and thawing in early spring. The slit method is preferable on sites of this character, since there is less danger of the soil heaving than there is when the soil has been loosened up in hole planting. In one plantation set by the hole method, large loss resulted from heaving of the trees. Regularity of planting is desirable in order to secure an even forest and uniform growing space for the trees. On rough Connecticut hillsides, regular spacing and exactly straight rows are an impossibility without great pains and additional cost, which is scarcely warranted. Distances need not be measured with exactness but careless spacing should be avoided. Laborers may be furnished six-foot rods or sticks to use until they learn to space the trees accurately. It is well to start on one straight side of the tract, if there is such, and work regularly back and forth. Stakes 5 or 6 feet tall should be set at the end of rows and one or two along the row. By these the laborers can line themselves in and keep the rows straight. If the first row is set straight, the other rows may be kept straight without setting stakes by lining with plants in adjoining planted rows. The following diagram illustrates this:



Forest planting should be carefully supervised. If only four or five laborers are engaged in it, one may be put in charge if he is capable; he may plant and at the same time direct the work of the others. If many laborers are employed it is better to have one foreman who spends his time entirely in supervision.

Cost of Planting.

Mention has already been made (see p. 488) of the average cost of forest planting. Many factors have an influence on the cost; such as size and price of trees, conditions of planting

site, spacing, price of labor, kind of labor and experience or inexperience in planting, nature of supervision, etc. Practically no information was given in reports of plantations as to these separate factors, the total cost figure being generally stated or the cost of trees and cost of setting them. Two-year seedlings have ranged from $2.50 to $3.50 per thousand in price in recent years, three-year transplants from $4.50 to $6.00 and four-year transplants $7.00 to $8.00 or more, per thousand. These prices are for conifers, none being available for the broadleaf trees planted. The latter would not ordinarily, however, exceed the prices given above. Close spacing increases cost, since more trees per acre are required. The price of labor does not vary to a great extent, but its quality is exceedingly variable. After a few days' experience two men, one digging holes and the other setting trees, can plant from 800 to 1,200 trees per day. If labor costs $1.75 per day, this would make the cost of planting the trees on a 6′ × 6′ spacing $3.50 to $5.25 per acre. Adding to this the cost of three-year-old transplants (figured at $5.50 per thousand) the cost of the planted trees per acre, exclusive of incidental expenses, would range from $10.10 to $11.85. With experienced labor and an open planting site this cost can be reduced somewhat. On more brushy sites it must inevitably be higher. If two-year-old seedlings are used, the cost is lowered by $2.50 to $3.00 per acre. Subsequent filling of failed places is liable to raise the net cost somewhat, however.

Planting under the slit method is faster and in many cases has been as successful as the hole method. On the basis of a 6′ × 6′ spacing, 1,200 trees to the acre, and the price per thousand $5.50 for three-year transplants, the average total cost of one extensive planting by this method was $9.29 per acre. In the case referred to, however, the average cost of 250,000 trees set in different years was $4.93, which would lower the average total cost to $8.61 per acre. The writer examined these plantations and some of them require partial replanting to make a complete stand. This would increase the total cost somewhat.

Careful planting is well worth while, but there cannot be the same care taken in planting or in preparation of the ground as is customary in ornamental or shade tree planting. In one series of large plantations in New Haven County in which some 200,000 trees have been planted, the work has been done pains-

takingly and what failures of plants occurred have been filled. Some land had to be cleaned of brush, etc., prior to planting, and the spacing was 5½ feet by 5½ feet, 1,440 trees to the acre. The total cost of trees, cleaning land, setting trees, some replanting and incidental expenses was $16.36 per acre. Replanting was found to be proportionately more expensive than the original planting. These plantations are in very good condition and probably the most nearly perfect of any in the state.

An owner in Litchfield County who has set 36,000 white pines, using his own farm labor, reports the total cost of trees, labor and incidental expenses as $8.00 per acre (spacing 5′ × 6′). The estimated per cent. alive is 75 to 80. He has not filled failed places. Such a low cost indicates the possibilities for planting by farmers at reasonable expense. In this case the low cost is due to intelligent personal supervision by the owner and the use of skilled farm labor. The land planted was open and grassy, with little brush, an average condition for open land planting. He reports that the men averaged more than one thousand trees each per day, an unusually large number. Planting done under contract has ranged in cost from $9.50 per acre (including cost of trees) to $16.25 per acre.

Losses and Replanting.

There are many causes of loss in forest planting. Death of trees may sometimes be traced to one or several of these, while in other instances it may be impossible to determine the cause. Some of the factors of loss can be controlled by the planter, such as planting poor stock in bad condition, allowing roots to dry out, careless planting, etc. Other factors, such as weather conditions, cannot be controlled. If, however, the former factors of loss are prevented, there is a much greater chance of success, even under adverse natural conditions following planting. Losses are most likely to occur during the first two years while the plants are establishing their root systems. Small slender trees with straggling roots, such as two-year white pine seedlings, suffer greater losses than stocky, well-rooted three-year-old transplants. The latter become established in their new site much more quickly, root deeper and are less subject to drought injury. This is upheld by observations of an owner in Litchfield County who has planted extensively on open land.

It is important that the trees be in good condition. Improper packing, long distance shipments, or unfavorable conditions in transit, may result in what is termed heated stock. Such trees have mouldy tops and even a scorched appearance, especially in the centers of bundles. In such cases the injured trees should be culled out or the shipment discarded and a new lot requested. There is relatively small danger of this trouble if stock is secured from nurseries in the state or near by. Trees should have a fresh, healthy appearance and the roots should be moist when received.

Care of the trees after arrival and until planted has been discussed (see p. 495). Conifers are very sensitive to the drying out of the fibrous roots. Subsequent losses will be heavy if the roots of the trees have been much exposed to sun and wind. Careless planting accounts for a great percentage of loss. In certain plantations the writer has traced whole rows where nearly every tree was dead, while adjoining rows showed scarcely one failure. It was evident that one laborer had been careless. This can be avoided by close supervision or better yet by discharging inefficient, careless laborers promptly on discovery. Careless planting may be detected by pulling on the plant after it is set to see that it is firm in the ground.

Planting early when the soil is fresh, the air cool, and the principal spring rains still to come, is most favorable to success. In later planting, losses are likely to occur, especially if a period of dry weather follows. Plantations on exposed sites, such as slopes with a south or southwest aspect, suffer severely from drought unless they have some protective vegetation, and heavy losses are likely to occur there. More trees die in plantations established on sod land than on poorer land with bunchy grass growth. In the former case, clearing away the sod where the tree is set will improve conditions. Several planters report a larger per cent. of the trees alive which were set on brushy land, in light birch growth, and on land "with some cover, not in grass, with some tall scattering trees," than on open sites.

Weather conditions are the greatest factor in success or failure in forest planting. The results in recent years have been very good considering the many unfavorable periods of long drought. A dry period in May and June is very hard on trees just set in forest plantations. A long summer drought in July and August

is especially trying because of the great heat of these months. A fall drought finds the trees more fully established and does less damage. Abundance of rainfall is not so important as a moderate amount of moisture well distributed throughout the growing season.

A compilation from the reports on the plantations of data on cost of planting, number of trees planted and percentage of trees living, showed no relation between the cost and the resultant stand. In plantings of all grades of cost, there were successes as well as more or less complete failures. High cost does not necessarily indicate great painstaking in planting, nor does low cost, on the other hand, indicate hasty, careless work. The average of living trees for all plantations in which this item was reported is a little over 70 per cent. A relatively small number were below 50 per cent., and many were 75 to 85 per cent. successful. If losses are greater than 20 per cent., the blanks should be replanted the year following first planting. In those plantations having losses of 20 per cent. or less the blanks need not be filled unless they occur in groups which would result in wide gaps in the stand. The purpose of replanting is to secure a full future yield from the soil and proper development of merchantable timber of good quality.

Damage to Plantations—Protective Measures.

No protective measures can be taken against loss by drought. It is not practicable, because of the high cost, to water the trees if a dry period ensues either when planting them or subsequently. In experiments at Rainbow on a dry, hot, sandy site, Norway spruce and white pine suffered damage from intense heat of the sun's rays and drying out of the soil. The plants were a foot to two and a half feet tall, and had grown under considerable shade of gray birch and pitch pine, hence were tender. The injury was caused by complete removal of the overgrowth during August in an experiment to ascertain whether cutting in that season would check undesirable sprouting of birch.

Late spring frost sometimes injures the new growth of pine and spruce, the latter being considerably more susceptible to this injury. It does not occur on slopes where air drainage is good, but on more level sites where cold air collects and is stagnant. In the spring following the experiment mentioned

above a late frost injured both species in numerous instances, but especially the spruce. The plot from which the birch growth was cleared was level and was surrounded on three sides by similar growth. It thus formed a sort of frost pocket, since air circulation was cut off by the adjoining growth. The needles of nursery transplants of pine are sometimes browned by winter injury, but this has not seemed to affect subsequent growth. Frost injury and drought injury sometimes produce a browning of the needles of older pines in plantations. The trees are weakened and some die, but loss has not generally been great in Connecticut from this cause. (See reports of Station Botanist for 1907 and 1909-10.) Only one case of frost injury to plantations of conifers was reported by private owners. This form of damage is not a prominent one. A light growth of brush, etc. may be of advantage on some planting sites since it affords protection from frost and winter injury. Catalpa has been reported to be winter killed in several localities.

Fire has destroyed small areas of planting in at least six instances, including one plot of an acre at Rainbow. The total area reported is about fifteen acres. Considering the total acreage planted, the loss is almost negligible. Coniferous plantations are especially susceptible to fire injury, and fire once started is difficult to stop. Two measures of prevention are suggested: (1) arousing of local interest in the plantation, its purpose and value; (2) an adequate system of fire lines. Both of these have combined to prevent serious damage by fire to the 100-acre tract of experimental planting by the Station at Rainbow in the town of Windsor. One fire started there on May 8, 1911, but was extinguished before it had covered more than an acre, the fire lines assisting greatly in stopping it.

Old roads through planted areas should be kept clear. In extensive plantations, cleared lanes bare of vegetation, dividing the area into smaller blocks, should be maintained if many causes of fire exist in the locality. Clearing inflammable material by burning along lines of danger, such as traveled roads, railroad lines, etc., will largely prevent danger from fire or prove of material assistance in checking fires. Posting of notices calling attention to the danger from fires and requesting coöperation in preventing them tends to educate local inhabitants and prevent

fires. Non-resident owners should pay a small sum to some local person residing nearby to watch out for fires in especially dangerous seasons.

Animals cause damage in plantations. In hardwood plantations grazing animals will browse the young trees down to the ground. In coniferous plantations trees are not usually eaten, but the ground is packed and small trees are trampled and deformed. Plantations should not be grazed in early years and in later years the crown canopy shades the ground, killing the grass, hence grazing is out of the question at any time. In five plantations, grazing injury as described was reported. In one instance where feed was poor, cattle browsed the needles from young Scotch pines.

Rodents do some damage in plantations. Squirrels will eat planted chestnuts or white oak acorns, often securing a majority of the nuts planted. Tarring the nuts is suggested as a preventive measure. Rabbits gnaw the bark of locust trees in late winter and in one instance killed the greater part of such a planting. They also bite off the shoots of red oak and keep the trees eaten down to small bunches of sprouts. This injury occurred in red oak plantations on sandy land at Rainbow. Shooting and poisoning are possible remedies. Field mice may gnaw the stems of white pines causing considerable injury, but only one case of this kind was reported. Remedy in any such instances is poisoning the mice, but it is recommended that special advice be asked from the Station Staff before poisoning is undertaken since, carelessly used, it will result in death to the natural enemies of the mice as well.

Insects and fungi are important sources of damage. The chief ones are the white pine weevil and the chestnut bark disease. For detailed information on these subjects, application should be made to Dr. W. E. Britton, State Entomologist, and Dr. G. P. Clinton, Station Botanist, New Haven, Conn. Specimens should accompany the description of insects or fungous diseases injuring plantations.

The larvae of the white pine weevil mine in the terminal shoots and cause trees to become deformed by loss of their leaders. In June and July, top shoots turn brown when so affected and new growth wilts. The best measures to adopt

are cutting off leading shoots below the injury and close to the next lower whorl of branches, burning these at once. If this is done early in July before the insect has emerged from the shoot in adult form, the numbers of the insect are materially reduced and the possibility of future damage is lessened. Serious damage has been done in plantations where no remedy has been applied. In 1911 weevil injury was reported from eighteen towns in plantations from five to ten years old.

Cleaning Plantations.

Pine plantations in which birch or other species have sprung up, and plantations set in brush or on cut-over land, require cleaning to prevent injury to the pines. Cleanings are usually made in stands from three to ten years old. Unless the interfering brush or small tree growth is cleaned out, many pines are killed by heavy shading, or are deformed by the competing worthless growth. The first cleaning should take place within two or three years after planting. One can give no definite rule as to the year, but must judge by the condition of the pines. There is no need of a painstaking costly removal of all growth other than the pines. In the first cleaning it is only necessary to go along the rows and to cut back to the ground with a bush hook or axe those bushes, sprouts and seedlings which directly interfere with the pines. Another cleaning may not be required but if within a few years the other growth again overtops the pines which grow slowly at the start, more work will be needed. In a second cleaning it will usually be unnecessary and of no advantage to cut the growth to the ground. It is better to cut it back so that it is below the tops of the pines. This will tend to check further sprouting and should also reduce the cost of the operation. Further cleaning will probably be unnecessary since the brush, etc. will then be crowded out rapidly by the pines.

Pruning.

Pruning of live branches is not recommended, since it reduces food producing foliage area. If the trees have been set at the proper distance apart, they will close together in two to twelve years and the lower branches will die for want of light. The dense shade also tends to conserve the moisture in the soil.

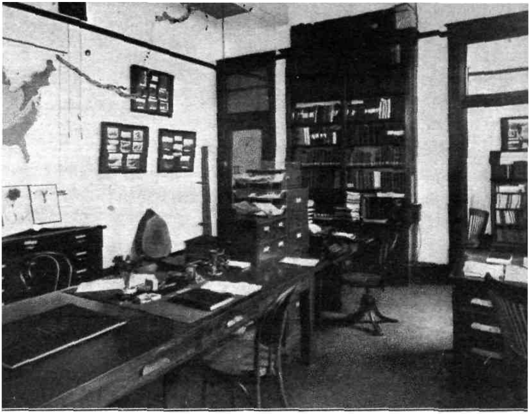
Subsequently the dead branches drop off, or may be cut and knocked off if the owners desire to undertake such expense in view of eventually producing clear saw timber. Considering the uses to which pine is usually put when cut, no material advantages come from trimming off dead branches.

Direct Seeding to Form a Forest.

Sowing or planting seed on the site where a forest is desired has been practiced to a small extent in Connecticut. In the case of conifers such as white pine, the seed may be broadcasted on unprepared or prepared ground at the rate of four or five pounds to the acre. Results are very uncertain and in experiments on sandy soil no trees were secured. The cost of seed and labor equals the cost of planting, while results in the latter case are much more sure. In Enfield, the Shakers started pine forests in this way on cultivated land some thirty years ago with success, but very large quantities of seed were used. Similar work to-day would be very costly and there are few sites susceptible of cultivation which will be put into pine. Partial seeding in prepared strips or in spots spaced 6′ × 6′ may be done at less cost, but experiments in this method with white pine have resulted in failure. Red oaks, chestnut and some other trees may be started from seed planted in spots on the site where forest is desired. The spots are prepared by scraping away the sod and after loosening the soil with a hoe or a mattock, two or three nuts or acorns are planted about an inch deep in the spot and the soil pressed down with the foot. A red oak plantation started in this way was entirely successful in one observed instance. Other plantings, especially of edible nuts, resulted in three-quarters loss. The nuts were given no protective treatment.

NOTE BY THE DIRECTOR.

Owing to the limits imposed by statute on the number of pages of the Station Report which may be printed at the State expense, an account of the other portions of the Station work done during the year cannot here be given.



Forester's office at Connecticut Agricultural Experiment Station.

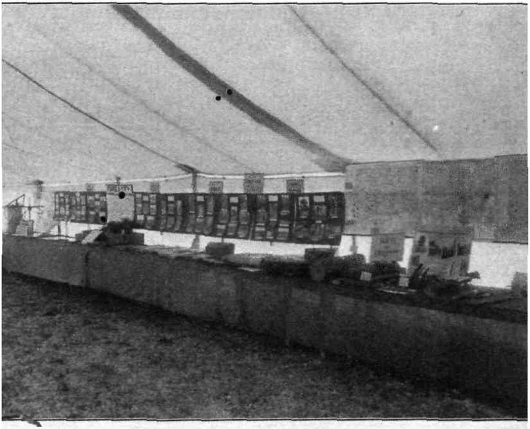
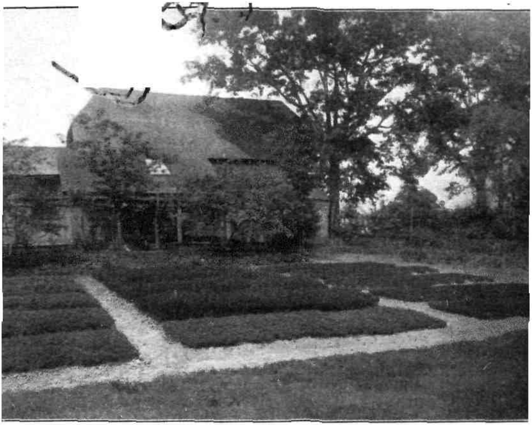
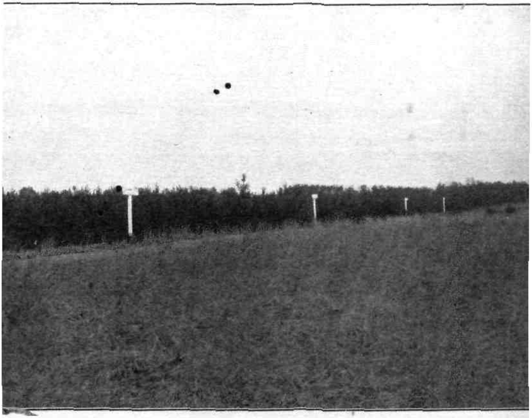


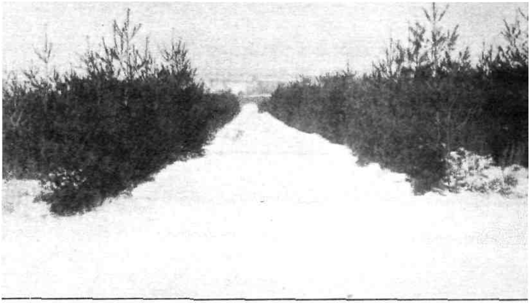
Exhibit of Forestry Department at Agricultural Fairs.



Seed-beds of white, Scotch and red pine on Station Grounds.

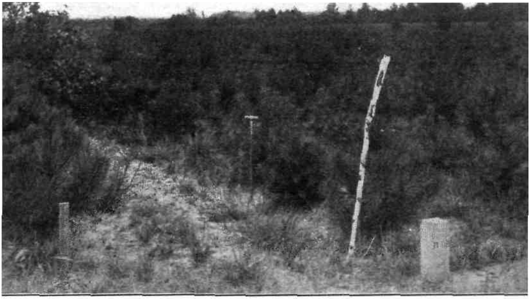


Pine plantations at Rainbow, plots 22–25.

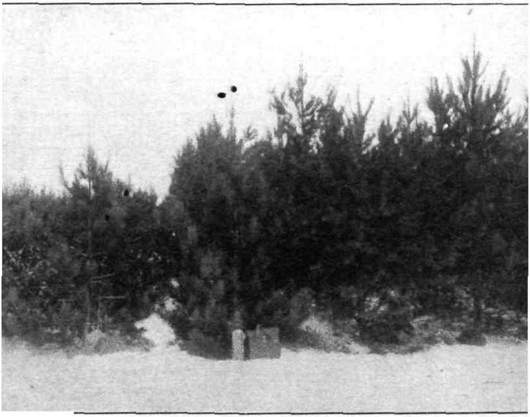


Fire lane between plots 60 and 68, Rainbow.

Interior of Scotch pine plantation, plot 23.



Red and Scotch pine on plots 22 and 23 in 1905.



Red and Scotch pine on plots 22 and 23 in 1912.

Eight-year-old white pine plantation on cut-over land.

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